EPA Comments and Responses on Draft Pre-Design Investigation Work Plan (dated October 26, 2020) Tasks 1, 2, and 8 River Mile 9 West Project Area

Comments dated January 25, 2021

To maintain the project schedule for the sampling proposed in the Draft Pre-Design Investigation Work Plan (PDI WP), a memorandum was submitted to the U.S. Environmental Protection Agency (EPA) dated January 15, 2021 that requested early EPA approval of PDI WP Tasks 1, 2, and 8 (Stormwater Memorandum). The Stormwater Memorandum included responses to EPA comments related to stormwater sampling activities proposed under Tasks 1, 2, and 8 from the PDI WP and associated modifications to the task scopes. This is EPA's conditional approval to proceed with PDI WP Tasks 1, 2, and 8 for the River Mile 9 West Project Area based on the modifications provided in the Stormwater Memorandum. The Stormwater Memorandum was prepared by Foth Infrastructure and Environment, LLC (Foth) on behalf of FMC Corporation (FMC). Approval is conditioned on FMC adequately addressing EPA's responses as described below.

The conditional approval excludes Attachment A that is included within Attachment 2 of the Stormwater Memorandum. Attachment A provides confined space entry procedures that fall within the scope of the Health and Safety Plan. EPA does not approve Health and Safety Plans but reviews for completeness, and did not have any technical comments on Attachment A.

EPA Comments on the Stormwater Memorandum

Unless otherwise noted, FMC's responses to EPA's comments on the Draft PDI WP that are provided in the Stormwater Memorandum are acceptable. However, clarification and supplemental information is provided below for the following comments: Specific Comments 10a and 11a. FMC did not provide a response to EPA Specific Comment 22; this comment has been reiterated below. Additionally, there are two EPA comments provided based on the new material and revisions presented in the Stormwater Memorandum. EPA expects that responses to these new comments are provided in the response to comment table when the revised PDI WP is submitted.

EPA Specific Comment 10a (December 8, 2020)

Section 4.1 Task 1: Storm Water Outfall and Conveyance System Sampling, page 17: EPA recommends that stormwater outfall sampling evaluate for all ROD Table 17 contaminants, not just recontamination potential chemicals (RPCs). Table 17 CULs are the long-term contaminant concentrations that need to be achieved to meet RAOs and are the appropriate benchmark for potential recontamination.

FMC Response (January 15, 2020)

FMC believes the appropriate analytes for the end of pipe stormwater and stormwater solids analyses are the Recontamination Potential Chemicals (RPCs) identified through the COC screening process in the Sufficiency Assessment Report (SAR). These are the analytes that are present within the RM9W Project

Area at concentrations above CULs and may be indicative of an on-going source with the potential to recontaminate the sediment remedy. As part of that COC screening process in the SAR, PAHs were screened out due to their limited frequency of exceedance (i.e. only a single surface sediment sample with a concentration equal to the RT). Therefore, PAHs and other surface water COCs are not being added to the storm water or storm water solids PDI analytical program. It is understood that attainment of RAOs over time will be determined as part of the long-term monitoring program for PHSS.

EPA Response (January 25, 2020)

As described in Section 9.1 of the record of decision (ROD), CULs identified in Table 17 of the ROD are the long-term contaminant concentrations that need to be achieved to meet RAOs. FMC may elect to sample stormwater and stormwater solids for only the analytes that were identified as RPCs in the SAR, but attainment of all Table 17 CULs remains an objective of the remedy and all Table 17 CULs will be evaluated during long-term performance monitoring of the remedy.

EPA Specific Comment 11a (December 8, 2020)

Section 4.1 Task 1: Storm Water Outfall and Conveyance System Sampling, pages 17-19: The PDI WP notes that OF-18 is submerged at high water. It is unclear whether the proposed stormwater sampling point at manhole AMZ094 is sufficiently far enough up-pipe to be out of the influence of the river backing up into the pipe. The PDI WP should provide rationale that proposed sampling (high volume sampling [HVS], manual grab, in-line solids traps and flow meter) will represent stormwater discharge from basin 18, rather than river water and any potentially entrained discharges from private outfalls near OF-18, or propose a different sampling location.

FMC Response (January 15, 2020)

The conveyance pipe at location AMZ094 is positioned at an elevation of approximately 12.5 ft COP (~14.5 ft NAVD88). Based on historical data, the AMZ094 vault will have river water present during episodes of high river stage, which typically occur in May and June. Most of the year, the river stage is below this elevation and all flow is toward the river. Because the primary objective of this sampling point is to obtain storm water and storm water solids data representative of combined Outfall Basin 18 discharge, FMC is planning to retain the AMZ094 sample location for the three targeted HVS sampling events. The sampling events will be planned to avoid periods of high river stage and potential river water influence. The HVS sample intake tubing will also be positioned above any accumulated sediment in the center of the storm flow to avoid inducing entrainment of bedded sediment directly into the tubing.

EPA Response (January 25, 2020)

Given the proposed timing of the start of stormwater sampling in February 2021, there may not be enough suitable sampling events during the proposed timeline (i.e., before October 2021) when river stage is not high and there is also sufficient stormwater flow for HVS sampling. Accordingly, EPA recommends identifying a contingency HVS sampling location up-pipe from AMZ094 that could be sampled if high river stage causes backflow at AMZ094 and prevents sampling at that location. During stormwater sampling events, the farthest downpipe location that does not contain river water should be sampled. The location that was sampled must be identified during each sampling event, and documentation must be provided to demonstrate that the water sampled is representative of stormwater discharge and does not contain river water (e.g., document pipe invert elevation at the sample location and water surface elevation in the river at the time of sampling).

EPA Specific Comment 22 (December 8, 2020)

Section 4.8 Task 8: Sediment Trap Sampling, pages 26: Clarify the rationale for each of the sediment trap locations and how areas where outfalls are discharging and propwash is occurring would be distinguished. For example, ST001 is located in the immediate area of a dock where erosion is consistently observed based on Figure 16, and proposed sediment traps are located in the vicinity of other private outfalls (Hampton at ST001 and Gunderson at ST003). The uncertainty associated with this and other factors such as propwash forces causing dispersion of sediment into sediment traps should be discussed in this section. In addition, if the data are intended to identify recontamination, revise text to state that the analyte list includes RPCs, not just driver COCs.

FMC Response (January 15, 2020)

No response provided.

EPA Response (January 25, 2020)

The Stormwater Memorandum requested expedited approval for PDI WP Tasks 1, 2, and 8. However, this comment on Task 8 was not addressed in the Stormwater Memorandum. EPA's conditional approval on the Stormwater Memorandum is contingent upon satisfactory response and edits to the Final PDI WP.

EPA Comments on New Information Presented in Stormwater Memorandum

1. FMC should consider extending the deployment time for the in-line sediment traps to capture solids during the rainy period after October 2021. Because the rainiest months in Portland are typically November through February, extending the deployment time would allow for sample collection when stormwater flows are expected to be the highest. If the deployment period is extended, EPA could discuss data reporting options with FMC.

2. Standard Operating Procedures (SOPs) that include confined space entry should include handheld meters for atmospheric testing of confined spaces in the list of equipment needed. Atmospheric testing is required in accordance with part 11 of the confined space entry permit form provided in Attachment A (FMC Standard OS-8 Permit Required Confined Space Entry) of Attachment 2 to the Stormwater Memorandum.

Memorandum

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January 15, 2021

TO: Josie Clark (USEPA)

CC: Christina Moretti (FMC), Jennifer Jones (CDM Smith)

FR: Erin Hughes (Foth)

RE: River Mile 9 West (RM9W) Upland Area, Request for Early USEPA Approval of Pre-Design Investigation Work Plan Tasks 1, 2, and 8

On December 30, 2019, FMC Corporation (FMC) and the U.S. Environmental Protection Agency (USEPA/Agency) voluntarily entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) (USEPA, 2019), to perform remedial design (RD) work within the River Mile 9 West (RM9W) Project Area of the Portland Harbor Superfund Site (PHSS), and the work described in this memorandum was performed in accordance with the ASAOC.

To facilitate completion of the Pre-Design Investigation (PDI) and maintain the project schedule, Foth Infrastructure & Environment, LLC (Foth) is requesting written authorization from USEPA to proceed with the PDI Task 1, Task 2, and Task 8 scopes as modified herein from the RM9W *Pre-Design Investigation Work Plan (PDI Work Plan)* (Foth, 2020), submitted in October 2020. The task scopes are modified in response to the results of the December 7, 2020 Storm Water Outfall and Conveyance system field reconnaissance task performed by Foth and Apex Companies LLC (Apex) and to Agency comments on those tasks. To finalize schedules, we request USEPA approval of the scope as soon as possible, and no later than 2 weeks prior to the first anticipated sampling date of February 8, 2021.

Storm Water Outfall and Conveyance System Sample Plan-Tasks 1, 2, and 8

As initially proposed in the October 2020 Draft *PDI Work Plan*, under **Task 1**, the *FSP* outlines three sampling activities that would target unique sample periods. These proposed locations are shown on Figures 5 and 6 of the *FSP*.

1. Grab samples of storm water solids from targeted public and private manholes will be collected in January 2021 over a period of approximately 3 days.

2. In-line sediment traps will be deployed within the City of Portland (City) conveyance system in January 2021 and left in place to collect storm water solids. The storm water solids that accumulate within the sediment traps will be sampled at the end of the first and second quarters to capture inputs during the rainy season. The in-line sediment traps will remain deployed over the summer months and left in place until after the first significant storm event(s) in the early fall, which typically occurs in late September or early October.

3. Three discrete storm events will be targeted over this same period for high volume sampling (HVS) storm water and storm water solids sample collection at the manholes closest to each of the three City outfalls. A single storm water grab sample will also be collected from within the City Outfall 18 during low water stage in the Willamette River, anticipated for September 2021.

Task 2 initially proposed storm water, storm water solids, and surface soil samples be collected in January 2021 from the Container Management Services property (ECSI 4784).

Task 8 initially proposed in-river sediment traps will be deployed in January 2021 and left in place to collect settleable suspended sediment from the water column. The solids that accumulate within the sediment traps would be sampled at the end of the first and second quarters to capture the variable inputs during the rainy season, when Willamette River levels are typically elevated. The sediment traps would remain deployed over the summer months, and be removed in early October, before the river levels begin to rise appreciably.

USEPA Pre-Design Investigation Work Plan Tasks 1, 2, and 8 Comments, dated December 2020

USEPA provided comments on the *PDI Work Plan* in December 2020. Comments specific to the storm water sampling activities proposed under Tasks 1, 2, and 8, and FMC's responses to those comments, are provided in Table 1.

December 2020 Storm Water Sampling Field Reconnaissance

On December 7, 2020, Apex, under oversight of Foth, conducted a field reconnaissance of storm water and storm water solids sampling locations proposed in Task 1 of the Draft *PDI Work Plan*, submitted to USEPA on October 26, 2020. The results of that field reconnaissance were documented in a Technical Memorandum, dated January 15, 2021 (Attachment 1).

In general, the proposed locations were considered favorable for the sampling activities outlined in the October 2020 Draft *PDI Work Plan* and *FSP*, with the exception of those sample locations discussed below:

- **AAX318**, **ANB317, and AAP931** – These manholes were not observed at the presumed locations.

- **AAP918** – The Apex field team encountered a City BES flow meter/HACH ISCO sampler blocking vault access and obscuring view of the pipe.

- **AMZ100 and AAT557** – No accumulated solids were observed within the conveyance system at these locations, limiting manual grab sample collection.

Several manholes were not accessed during field reconnaissance due to their location in a public street right-of-way including AAX381, AAX186, AND535, AAT497, ANB317, and AAP931.

Proposed Revisions to the Draft PDI Work Plan

This section summarizes revisions proposed to Tasks 1, 2, and 8 of the Draft *PDI Work Plan,* submitted to USEPA on October 26, 2020. The adjustments proposed are based on one or more of the following conditions:

- Accessibility issues identified during field reconnaissance activities performed on December 7, 2020 that require sample relocation, as discussed in Attachment 1.

- Comments provided to the Draft *PDI Work Plan*, by USEPA and the Technical Coordination Team (TCT), presented to FMC, on December 8, 2020.

- Updates to Stormwater Source Control Sufficiency Status at Front LP and Gunderson properties.

Table 2, of this memorandum, presents a redline comparison of the sampling approach that was proposed in Table 10 of the October 2020 Draft *PDI Work Plan* and the revised approach that is being presented for early Agency approval. This revised plan, as approved by USEPA, will be included in the Final *PDI Work Plan*. Similarly, Figures 5 and 6, of the *FSP*, have been revised to show the changes reflected in Table 2. The revised figures are provided here as Figures 1 and 2.

Task 1 Storm Water Outfall and Conveyance System Sampling Revisions

In response to USEPA's *FSP* Comment G3, standard operating procedures (SOP) are provided as Attachments 2, 3, and 4 to this memorandum and will be incorporated into the Final *PDI Work Plan*. The *FSP* will also be updated to include additional detail on sample methods and the supporting SOPs. A summary of the sampling methods is provided below.

Sampling Methods

- **Manual Grab Samples:** Manual storm water solid grab samples will be collected at time of entry as long as a minimum of 8 ounces (oz.) of solids are present. If less than 8 oz. of solids are present, then the manual grab sample location shall be abandoned and alternative locations, if and as identified in Table 2, will be inspected and one of the alternative locations will be sampled, if at least 8 oz. of sediment is present. Alternative locations without at least 8 oz. of sediment present will be abandoned. Additional details on sample methodology are provided in the Apex SOP#1.1, which is provided in Attachment 2.

- **In-Line Sediment Trap Samples:** The in-line sediment trap design will be similar to that utilized in the USEPA-approved Round 3A Stormwater Field Sampling Plan, Portland Harbor RI/FS (LWG, 2007). To improve the probability of collecting sufficient solids, four 1-liter bottles (instead of two) per location will be secured in place using stainless steel brackets bolted inside the storm water pipes. With four in-line traps at each location, there should be enough storm water solids collected so as to avoid moving any of the in-line traps from the planned locations. Per discussions with USEPA and Oregon Department of Environmental Quality (ODEQ), on January 8, 2021, the deployment period will consist of two sampling intervals, February through June and July through mid-October, 2021. Additional details on trap design, sample methodology and flow monitoring are provided in Apex SOP#1.2 and SOP#1.3, which are provided in Attachments 3 and 4, respectively.

- **High Volume System (HVS) Sampling:** The HVS sampling methodology includes pumping storm water at a consistent rate over the duration of the storm and running high-volumes of water through the HVS to distinguish between the dissolved and solids fractions. Additional detail is provided in the Gravity SOP#SW-27, which is provided in Attachment 5.

Revised Storm Water and Storm Water Solids Sampling Locations

1. **City Storm Water and Storm Water Solids Sampling Locations (*PDI Work Plan* Task 1)**

    - **AAX318** – This manhole was not located in the field. Subsequent ODEQ comments suggest that it may still be present, and a desirable sampling location. As such, the field crew will contact the City of Portland and make a second attempt to locate it. If not located, the field crew will move to a proposed alternate location **AAX278** which is located about 580 feet downpipe on the sidewalk adjacent to 35th Avenue in the same storm water conveyance line.

- **ANB317** – Will be moved to **AMZ076** which is located approximately 150 feet up-pipe in the center southward driving lane of St. Helens Road in the same storm water conveyance line.

- **AAP931** – Will be replaced (along with AAP918 as discussed below) by **AAP929** which is located approximately 375 feet down-pipe on the Calbag Metals private property in the same storm water conveyance line.

- **AAP918** – Existing City of Portland sampling equipment was identified at this location during the field reconnaissance. Subsequent discussion with the City indicated a specific date for removal of the equipment was not available. As a result, this location will be removed from the PDI scope, and replaced with locations **AAP904** and **AAP929** for different sample media. Two replacement locations are proposed given USEPA Comment 11 regarding river influence during sampling activities. HVS sampling will be conducted at **AAP904** when the river stage is below the elevation of the conveyance line at this location. The in-line sediment trap will be deployed at location **AAP929** due to its location above the elevation of the river stage.

- **AMZ094** –To avoid river water influence during long term sampling, the in-line sediment traps and manual grab samples will be collected from an up-pipe conveyance system location **AMZ087**. No adjustments are proposed to the HVS sample proposed at location AMZ094. (See Table 1, FMC Response to USEPA Comment 11.)

- **Alternative Locations for Manual Grab Samples –** To facilitate decision making in the field, and to obtain early Agency approval and City authorization for sampling, potential alternative sampling manholes have been identified for visual reconnaissance and potential sampling if the initial targeted sampling location does not produce ample storm water solids for manual grab sampling. The potential alternate locations for each target sample are listed in Table 2 and shown on Figures 1 and 2.

2. Private Sampling Locations (*PDI Work Plan* Task 1)

- **Front LP Properties (C-5, SW-1, and WR-7)** – Front LP Properties communicated that it has removed the legacy solids remaining in the main conveyance line between the TFA and Glacier treatment (December 3 and 10, 2020 email correspondence, from Scott Jerger, of Field Jerger LLP, and Erin Hughes, of Foth). Due to this removal of legacy solids from the line and the extensive source control work completed at both properties to address BEHP, manhole locations C-5, SW-1 and the location upstream of WR-7 will not be included in the *PDI Work Plan* storm water sampling task. (See Table 1, FMC Response to USEPA Comment 12.)

- **Gunderson WR-138** – It was determined that this location is not accessible for sampling, and also confirmed that this location is no longer considered a potential ongoing source. Gunderson communicated that it has disconnected their catch basins in this area, and that as a result surficial runoff and entrained solids can no longer enter the conveyance system (email communication from Chris Breemer, Cascadia Associates, to Erin Hughes, Foth, dated December 22, 2020). Because the believed on-going source of contaminants of concern (COC) has been removed, this proposed sample location will not be included in the *PDI Work Plan* storm water sampling task. (See Table 1, FMC Response to USEPA Comment 12.)

Task 2 Upland Sampling at Container Management Services

- Sampling of the Container Management Services (CMS) property (ECSI 4784) was proposed under Task 2 to evaluate the degree to which surface soils, impacted by historic industrial operations, have the potential to be entrained in overland flow and to enter the City's storm water conveyance systems, and to be an ongoing source of contamination to sediment in the RM9W Project Area. On September 28, 2020, FMC submitted a request for access to IMACC Corporation (IMACC), the current owner of the former CMS property. IMACC responded on October 2, 2020 that no access will be granted for PDI activities or any other remedial design work. During a Project Coordinator meeting and in its quarterly progress report #3, FMC informed USEPA and ODEQ of IMACC's refusal to allow access. Based on the recommendation from USEPA and ODEQ in the Comment Letter to the Draft *PDI Work Plan* (see Table 1, FMC Response to USEPA Comment PDI WP S13), the sample plan at the CMS property has been revised to include collection of three surface soil composite samples in the BNSF Right of Way and collection of one surface soil sample adjacent to the site on the unpaved Lake Street. These areas remain potential on-going sources of polychlorinated biphenyls (PCBs) and dioxin/furans to the City's conveyance system, given they are not proposed for paving as part of source control measures proposed by IMACC. Table 3 and Figure 3 are provided here to illustrate the new proposed sample locations. This table and figure will replace Table 11 of the Draft *PDI Work Plan* and Figure 7 of the Draft *FSP*, respectively.

Task 8 In-River Sediment Traps

- USEPA Comment *FSP* S8 (Table 1) requests an SOP for the deployment of the in-river sediment traps. Gravity SOP#SW-31 has been prepared and is provided in Attachment 6. Per discussions with USEPA and ODEQ on January 8, 2021, the deployment period will consist of two sampling intervals, February through June and July through mid-October 2021.

Anticipated Field Schedule for Revised PDI Task 1, 2, 8

The proposed field schedule for these early approval tasks is as follows:

- In-River Sediment Trap Deployment by Gravity: Week of February 8, 2020
- Manual Grabs and In-Line Sediment Trap Installation by Apex: Week of February 15, 2020.
- HVS Sampling Event #1 by Gravity: Targets qualifying storm sometime during the month of February 2021.
- Retrieval of in-line and in-river sediment traps by Apex and Gravity: June and October, 2021.

The final field schedule may vary, depending upon timing of receipt of USEPA approval, timing of all necessary authorizations from the City, obtaining final access permission from several private property owners, and weather conditions.

References

U.S. Environmental Protection Agency, 2019a. *Administrative Settlement Agreement and Order on Consent for Remedial Design at River Mile 9 West Project Area.* CERCLA Docket No. 10-2020-0038, Region 10. December 20, 2019.

Foth Infrastructure & Environment, LLC, 2020. *Pre-Design Investigation Work Plan*. October 2020.

Tables

Table 1
Response to EPA Comments Related to Storm Water Sampling in PDI Tasks 1 and 2

Report	Comment Number	Specific Section	Comment	FMC Response
PDI WP	S10	4.1	Task 1: Storm Water Outfall and Conveyance System Sampling, page 17: a. EPA recommends that stormwater outfall sampling evaluate for all ROD Table 17 contaminants, not just recontamination potential chemicals (RPCs). Table 17 CULs are the long-term contaminant concentrations that need to be achieved to meet RAOs and are the appropriate benchmark for potential recontamination. b. Total suspended solids should be included in the analyte list for all stormwater samples. c. Additional stormwater sampling for dioxins/furans (D/F) is warranted and a phased approach to additional solids sampling is recommended, following confirmation of the presence of sources in discharges to the river at concentrations that could result in recontamination of sediment. Solids sampling would then be helpful in source tracing, when collected from discrete locations associated with a confirmed source in stormwater. Concurrent with bottom of basin sampling, observations can be conducted to confirm theorized overland flows to stormwater conveyances, as recommended in the SAR. Observations should be conducted along the right-of-way composing basin 19A, at Tube Forgings and Conoco frontage along Front Ave, at PGE Forest Park frontage along St Helens Rd, and at all non-ECSI sites within basin 18. EPA recommends that, following confirmation of significant sources in discharges to the river and measurable volumes of observed overland flows, a plan for discrete sampling of up-pipe stormwater, solids and soils then be devised, as warranted d. Based on information from DEQ, and as discussed on November 13, 2020, the up-pipe sampling locations identified on Figures 8-11 (and Figures 5 and 6 in the FSP) and Table 10 will be of limited use in assessing recontamination potential, informing remedial design or identifying uncontrolled contaminant sources because they: • Do not represent stormwater discharges to the river; • Have not been confirmed to represent runoff contributions from target sites (DEQ previously confirmed that Pennzoil does not contribute runoff to basin 18; only half of the Wirfs site could contribute runoff to the basin, which would flow to treatment swales within the City right-of-way; and now confirms that runoff leaving PGE Forest Park has been observed to infiltrate at the curb, likely into abandoned pipe bedding); • May not allow differentiation between contributions of stormwater or solids from targeted sites, other sites contributing discharge and, in some cases, confluences of several disparate private and public lines (AAP913, AAP918, AMZ094, AND536, AAX381, AAX265); and • Also capture/convey flows from multiple Forest Park streams (ANB317, AAT497, AAP931, AAP913, AND535, AAX265, AAX381, AAX186), which will confound interpretation of data, particularly at locations nearest stream input points (AAX186, AAX265, AAX381, ANB317 and AAT497).	- FMC believes the appropriate analytes for the end of pipe stormwater and stormwater solids analyses are the Recontamination Potential Chemicals (RPCs) identified through the COC screening process in the Sufficiency Assessment Report (SAR). These are the analytes that are present within the RM9W Project Area at concentrations above CULs, and may be indicative of an on-going source with the potential to recontaminate the sediment remedy. As part of that COC screening process in the SAR, PAHs were screened out due to their limited frequency of exceedance (i.e. only a single surface sediment sample with a concentration equal to the RT). Therefore, PAHs and other surface water COCs are not being added to the storm water or storm water solids PDI analytical program. It is understood that attainment of RAOs over time will be determined as part of the long-term monitoring program for PHSS. - Only the organic Driver COC contaminants can be analyzed using the HVS sampling method due to the adsorptive filter media and system. To address this comment, a second time-weighted stormwater sample will be collected at the HVS sample locations, centrifuged by the laboratory, and analyzed for the remaining RPCs (i.e. metals and BEHP) to inform the evaluation of recontamination potential. A second sampling line is now proposed during the HVS stormwater sampling event such that field parameters, including TSS, can be measured and a separate water sample can be collected for analysis of the remaining RPCs. - FMC will proceed with the sampling approach laid out. In addition to potential on-going sources and transport through overland flow, FMC is concerned that legacy solids are present at concentrations exceeding RTs and/or CULs, and believes it is necessary to assess their relative concentrations observed in each main branch of the storm water conveyance system. This information is expected to identify areas where further in-pipe or upland source control investigation and action may be necessary to address the potential for storm water solids to recontaminate the sediment remedy.
PDI WP	S11	4.1	Task 1: Storm Water Outfall and Conveyance System Sampling, pages 17-19: a. The PDI WP notes that OF-18 is submerged at high water. It is unclear whether the proposed stormwater sampling point at manhole AMZ094 is sufficiently far enough up-pipe to be out of the influence of the river backing up into the pipe The PDI WP should provide rationale that proposed sampling (high volume sampling [HVS], manual grab, in-line solids traps and flow meter) will represent stormwater discharge from basin 18, rather than river water and any potentially entrained discharges from private outfalls near OF-18, or propose a different sampling location.	The conveyance pipe at location AMZ094 is positioned at an elevation of approximately 12.5 ft COP (~14.5 ft NAVD88). Based on historical data, the AMZ094 vault will have river water present during episodes of high river stage, which typically occur in May and June. Most of the year, the river stage is below this elevation and all flow is toward the river. Because the primary objective of this sampling point is to obtain storm water and storm water solids data representative of combined Outfall Basin 18 discharge, FMC is planning to retain the AMZ094 sample location for the three targeted HVS sampling events. The sampling events will be planned to avoid periods of high river stage and potential river water influence. The HVS sample intake tubing will also be positioned above any accumulated sediment in the center of the storm flow to avoid inducing entrainment of bedded sediment directly into the tubing.

Table 1 ***(continued)***

Report	Comment Number	Specific Section	Comment	FMC Response
PDI WP	S11	4.1	Task 1: Storm Water Outfall and Conveyance System Sampling, pages 17-19: b. Clarify whether the presence of solids at OF-18 has been confirmed. Discuss how analysis of sampling results will distinguish between river deposited solids and the planned sampling up-pipe of a time-integrated inline solids trap and snap shot of solids filtered from the HVS process. The PDI WP should provide additional information to support the proposed sampling.	Solids were confirmed to be present at AMZ094 during the December 7, 2020 Site Reconnaissance. At the terminus of OF-18 it is estimated that solids will represent a combination of storm water- and river-derived sediment. In an effort to find a location that is out of the influence of river deposition, FMC is proposing moving the manual grab sample and in-line sediment trap from this location 0.25 miles up pipe to AMZ087, on the north side of Yeon Ave. Note that the OF-18 stormwater pipes, even at this location, are at an elevation (13.4 ft COP) which is still below the seasonal Willamette River Stage peaks observed for short periods of time in May and June most years. It is however anticipated that solids from the Willamette River are unlikely to travel this far up-pipe.
PDI WP	S12	4.1	**Task 1: Storm Water Outfall and Conveyance System Sampling, page 18**: The proposed single grab sample of stormwater solids does not adequately address the data gaps identified for stormwater discharging from Gunderson and Front LP Properties and stormwater sampling is needed to fill data gaps. The PDI WP indicates these two facilities were identified for sampling based on elevated contaminant concentrations in previous samples. Additionally, there are RAL exceedances of dioxins/furans in sediment at the RM9W project area in the vicinity of Gunderson Area 2, but previous stormwater samples collected from outfalls that discharge to contaminated areas have not been sampled for dioxins/furans. Stormwater samples should be collected at Front LP Properties outfall WR-7 and outfall(s) representative of stormwater discharges from the Gunderson facility (e.g., WR-138). EPA recommends revising the PDI WP and the FSP to include stormwater sampling at these locations. Stormwater sampling methods should conform to Appendix D of the Joint Source Control Strategy (JSCS) (DEQ and EPA 2005).	- Following submission of the Draft PDI WP, FMC was informed that Front LP Properties had video surveyed the main conveyance line between the TFA and Glacier treatment areas and subsequently removed the legacy solids remaining in the line. Due to the removal of legacy solids from the line and the extensive source control work completed at both properties to address BEHP, this private outfall no longer represents a data gap. Stormwater solids sampling at this site is no longer included in the PDI scope, and has been removed from the PDI WP. - Similarly, Gunderson has decommissioned the former WR-138 catch-basins that drained to this outfall and currently only roof drains from the Craneways building drain to WR-138. Because any pathway to the river has now been cut off, this private outfall no longer represents a data gap, stormwater solids sampling at this area is no longer included in the PDI scope, and has been removed from the PDI WP. - Regarding dioxins and furans at Gunderson, the SAR specifically identified Area 3 as a potential concern due to historical practices that may have been attributed to dioxins and furans. Because all of the Area 3 outfalls have been converted to infiltration and discharge from outfalls no longer occurs in this portion of the site, direct stormwater drainage from Area 3 no longer represents a data gap and stormwater solids sampling in this area is not possible. Note that no historical dioxin/furan source was identified at Area 2 of Gunderson and thus no dioxin/furan sampling of stormwater is planned for this PDI.
PDI WP	S13	4.2	**Task 2: Upland Site Reconnaissance and Sampling, page 19**: Based on information from DEQ, Container Management Services recently vacated the site and anticipates the site owner's proposal to pave the site and infiltrate stormwater to eliminate future discharges to proceed expeditiously. While the data proposed for collection in this section may still be informative for source identification, completion of these source control actions will render the data not representative of post-source control measures (SCM) site conditions for recontamination assessment purposes. SCMs have not yet been proposed for unpaved Lake St, used by Container Management for equipment storage and site egress/ingress and known to have significant contamination. Reoccupation of post-line cleanout stormwater solids collection locations (ANF164, ANB621, ANB622 and APN941) or sediment trap locations (AAX318 and AAX278), which were previously traced to Container Management inputs and sampled by the City of Portland, should be considered. This sampling would be more helpful in evaluating on-going contributions from the site to the OF18 conveyance system than solids, soil, and stormwater sampling proposed in and around the site's stormwater system or the single solids grab sample proposed within AAX318.	IMACC Corporation will not grant FMC access to their property for the PDI work. Accordingly, the stormwater sampling previously proposed on-site under PDI Task 2 has been replaced by collection of three surface soil composite samples in the Railroad ROW, and one adjacent to the site on the unpaved Lake Street. Because these areas are not proposed for paving, they continue to be potential on-going sources of PCBs and dioxin/furans to the City's conveyance system.

Table 1 *(continued)*

Report	Comment Number	Specific Section	Comment	FMC Response
FSP	S2	2.1.1	**Section 2.1.1 HVS System Sample Design, pages 5-6:** Because contaminant concentrations are typically highest in initial runoff (i.e., the "first flush"), samples must include this portion of stormwater runoff to ensure contaminants are adequately characterized by the samples. Revise the text to clarify the timing of sample collection and verify that the first flush will be included in the sample.	FSP Section 2.1.1 will be updated to clarify that stormwater solids collected during the representative storm events will include the "first flush" initial run-off.
FSP	S3	2.1.1	**Section 2.1.1 HVS System Sample Design, page 5-6**: The collection of stormwater flow data should be described in Section 2 of the FSP. The PDI WP and Sections 2.1.1 and 2.1.3 of the FSP describe that stormwater flow will be measured continuously from January 2021 to October 2021. The type of flow meter that will be used, installation procedures, operations and maintenance requirements (including calibration), and frequency of data downloads should be included in the FSP.	FSP Section 2.1.1 will be updated to describe the collection procedures for flow data including the type of flow meter that will be used, installation procedures, operations and maintenance requirements (including calibration), and frequency of data downloads. A SOP containing this information will also be provided to EPA for approval prior to submitting the final PDI WP.
FSP	S4	2.1.1	**Section 2.1.1 HVS System Sample Design, page 5:** Consider whether HVS is feasible at City Outfall Basin 19A and revise the sampling methodology as needed. City Outfall Basin 19A is only 1.7 acres (City of Portland 2013), and there may not be enough runoff to collect a high volume sample. Clarify what alternative method would be used if there is not enough sample volume for HVS.	FMC acknowledges the limited basin capture for OF-19A which could result in limited flow volume and duration of flow for the HVS especially during the fall sampling event. The HVS will target the optimal 200 liter total volume collected at the average 1.5 L/min pump rate although, if the storm flow volume and/or flow period does not allow for this sample volume from an attempted single storm event (as described in the JSCS DEQ and EPA 2005), the sample will still be collected at an adjusted flow rate as long as the storm allows. The effect of pumping less than the optimal 200 liter minimum through the HVS system will affect the achievable laboratory detection limit, although even with limited volume the detection limits performed on the HVS samples are well below the levels achieved via conventional laboratory analyses, this discussion will be included in the FSP.
FSP	S5	2.1.1	**Section 2.1.1 HVS System Sample Design, page 6:** The selection of storm events should conform to criteria described in Appendix D of the Joint Source Control Strategy (JSCS) (DEQ and EPA 2005). Namely, storm events must comply with the following criteria: a. Antecedent dry period of at least 24 hours (as defined by less than 0.1 inch over the previous 24 hours) b. Minimum predicted rainfall volume of greater than 0.2 inch per event c. Expected duration of storm event of at least 3 hours Precipitation data (and outfall discharge data, if available) should be collected or acquired to provide hydrologic context for stormwater samples.	Section 2.1.1 will be revised to include discussion of the selection of storm events that should conform to criteria described in Appendix D of the Joint Source Control Strategy (JSCS) (DEQ and EPA 2005).

Table 1 ***(continued)***

Report	Comment Number	Specific Section	Comment	FMC Response
FSP	S6	2.2.1	**Section 2.1.1 HVS Sampling Methodology, pages 7-8**: Clarify the following aspects of the HVS sampling methodology: a. Specify the minimum volume of sample needed to achieve sampling objectives. The text indicates that water will be pumped at "up to 1.5 liters per minute." Therefore, to achieve the stated volume of 200 liters, sampling would continue for a minimum of 2 hours and 13 minutes. It is unclear whether the sampling approach can be modified if there is not continuous stormwater runoff over this time period b. Describe how stormwater concentrations (i.e., mass contaminant per volume water) will be determined. Solids will be collected in the vortex separator and from the 0.45-micron glass fiber filter and will presumably represent the particulate fraction. The FSP should describe that contaminants that adsorb to the polyurethane foam (PUF) cartridge will represent the dissolved fraction. The FSP should include the calculation for determining a total stormwater concentration from the particulate and dissolved fractions. In addition, total suspended solids should be analyzed in the stormwater samples c. Describe how water samples will be collected to clarify that both the dissolved and particulate fractions will be analyzed and used to calculate a total (i.e., whole water) concentration. Contaminants other than PCBs, PAHs, and D/F will be present in both the dissolved and particulate phase, so the separation and filtration procedures that are described are not appropriate for those contaminants d. Revise Table 5 to identify the sample containers, preservation, and holding times for samples collected using HVS methodology. The revised table should identify which analytes will be collected as water samples and which will be collected as solids using the separation and filtration process described in Section 2.2.1	See response to FSP Comment S4. In addition: -The HVS sampling can be paused during a single storm event if the stormwater flow temporarily subsides due to fluctuating precipitation rates. The JSCS (DEQ and EPA 2005) guidelines on single storm event criteria and duration will be referenced. -The FSP will be revised to describe the calculation for determining a total stormwater concentration from the particulate and dissolved fractions and how the particulate and dissolved stormwater fractions are collected. The FSP will also include an HVS methodology SOP. Total suspended solids analyses will be included. -Section 2.2.1 and the HVS SOP will describe the process of both dissolved and particulate sample collection and analyses, as well as the collection of whole water conventional parameters. The method will allow for the analyses for dissolved and particulate RM9W Driver COCs. -Section 2.2.1 Table 5 will be revised to identify all water and filter derived sample containers and holding times.
FSP	S7	2.2.2	**Manual Grab Sampling Methodology, page 8:** EPA has the following comments on this section and the FSP should be revised accordingly: -This section states that sampling will be conducted in accordance with a forthcoming SOP from a subcontractor, to be provided in the Final PDI WP. This SOP needs to be provided for EPA review prior to finalizing the PDI WP -If an alternative manhole is proposed for sampling, this should be communicated to EPA via a field change request form for EPA review and approval prior to sample collection. Update the text to detail this communication process.	Comment noted. The final SOP will be provided to EPA for approval prior to submitting the final PDI WP. To facilitate completion of the task and minimize decision making in the field or the need for field change request forms, FMC will pre-designate potential alternative sample locations in the early authorization request to EPA such that the potential back-up sampling locations are known and authorized prior to the fieldwork. That will allow the field team to move on to the back-up location should insufficient quantity of solids be present in the target location.
FSP	S8	2.2.4	**In-Line Sediment Trap Sampling Methodology, page 9:** EPA has the following comments on this section and the FSP should be revised accordingly: -This section states that sampling will be conducted in accordance with a forthcoming SOP from a subcontractor, to be provided in the Final PDI WP. This SOP needs to be provided for EPA review prior to finalizing the PDI WP -Provide a more detailed description of the in-line sediment traps including height and size of the bottles, how many bottles, their orientation, etc.	Comment noted. The final SOP will be provided to EPA for approval prior to submitting the final PDI WP. The SOP will describe the design and application of the sediment trap methodology.

Table 1 ***(continued)***

Report	Comment Number	Specific Section	Comment	FMC Response
FSP	S9	2.3	**Contingency Plan, page 10:** The text states that if in-line sediment traps do not have sufficient volume following the first quarterly retrieval, the traps may be relocated, or additional bottles may be added. EPA suggests that additional bottles and additional sediment traps should be considered to avoid moving traps and therefore preserve geographic representation of each trap	The revised FSP and associated SOP will describe a sediment trap design that is similar to that utilized in the EPA-approved Round 3A Stormwater Field Sampling Plan, Portland Harbor RI/FS (LWG, 2007). But instead of deploying just two bottles per location, four 1-liter bottles will be secured in place using stainless steel brackets bolted inside the stormwater pipes. With four in-line traps at each location sufficient stormwater solids are expected to be collected, obviating the need to move any of the in-line traps from the planned locations.
FSP	S10	3.2.1	**Storm Water Sampling Methodology, page 11:** This section states that sampling will be conducted in accordance with a forthcoming SOP from a subcontractor, to be provided in the Final PDI WP. This SOP needs to be provided for EPA review prior to finalizing the PDI WP.	Comment noted. The final SOP will be provided to EPA for approval prior to submitting the final PDI WP.
FSP	S11	3.2.3	**Surface Soil Sampling, page 12:** EPA has the following comments on this section and the text should be revised accordingly: -The text states that coordinates will be collected with a hand-held GPS. This is not a specific procedure. Sample locating, coordinate collection, and precision and accuracy standards need to be presented clearly and a reference must be made to Section 11 -The description of the surface soil intervals is unclear. Revise the text to clarify what type of surface debris will be removed, how thick the gravel layer is expected to be, and if the shallow interval is intended to be 0 to 6 inches or only the gravel layer -Clarify the sentence, “Soil aliquots from the surficial and sub-gravel intervals will be combined from the five discrete sample locations and placed in a disposable aluminum tray.” to indicate that shallow intervals with be composited with each other and separately the deeper intervals will be composited with each other.	The Final FSP will be edited to reference location positioning in Section 11. It will also clarify that the upper 6-inch samples will be composited separately from the 6 to 12-inch layer samples. The layers will be sampled as-is, with no surface debris or gravel removed. If no soil is encountered within the top 12 inches, an additional 6-inch sample will be collected.
PDI WP	S27	Table 5	This table retains information from the conditionally approved SAR and will need to be updated for the next SAR submittal. As noted in EPA comments on the SAR, classification of C status for many sites **is incorrect**, as DEQ is currently evaluating the stormwater pathway and has communicated that current data and information indicate they are controlled or excluded due to the stormwater pathway being incomplete (including potentially complete, but insignificant). **EPA** disagrees with C status for the following sites: Gunderson, Tube Forgings, Hampton, City of Portland, Wilhelm, BNSF – Guilds Lake, Univar, Trumball, ANRFS, Wirfs and Penzoil.	Comment Noted. The results of the PDI will further inform source control statuses for these ECSI sites for the Final SAR. Table will be left "as is" for consistency with the Revised Draft SAR and a footnote will be added referencing the revised draft and stating that the stormwater status will be revisited and updated in the Final SAR.
PDI WP	S35	Table 10	EPA recommends the analyte list for stormwater and stormwater solids samples include all ROD Table 17 surface water and riverbank soil/sediment contaminants, respectively. At a minimum, sample for RPCs and total PAHs if the data are intended to address recontamination potential data gaps. Also see Specific Comment 10.	The primary purpose of these samples is to identify sources with concentrations that may influence the sediment management area (SMA) footprints. Such sources, if present, could impact whether and how remedial design can proceed. This purpose will be achieved by prioritizing Driver COCs in the up-pipe locations. Per response to Specific Comment 10, analysis of RPCs (i.e., BEHP and metals) have been added at the four downstream most “end of pipe” sample locations and will help address recontamination data gaps and inform the relative loading evaluation in the Final SAR. As part of the screening process, PAHs were screened out due to their limited frequency of exceedance (i.e. only one single surface sediment sample with a concentration equal to the RT). Therefore, PAHs and other surface water COCs are not being added to the storm water or storm water solids PDI analytical program. It is understood that attainment of RAOs over time will be determined as part of the long-term monitoring program for PHSS.
QAPP	S21	Tables 5 and 6	Update Tables 5 and 6 in the Final QAPP to show laboratory quantitation limits for each analytical group. On Table 6 the units should be in mass per sample for the HVS stormwater samples, assuming that is how the laboratory will be reporting the results for the particulate and dissolved fraction samples.	Quantitation limits will be added to Tables 5 and 6 of the QAPP.

Table 2
Storm Water Outfall and Conveyance System Sampling Locations, Rationale, and Analytical Approach

Outfall Basin	Manhole Sample Locations	Potential Alternative Sample Locations	B and C-Status Properties within Drainage Sub-Basin[5]	Sample Media and Proposed Analytical Suite					
				Storm Water			Storm Water Solids		
				Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Sample Collection Method(s)
City Outfall Basin 18 Sampling Locations									
OF-18 Eastern Subbasin	AMZ100	AMZ101, AMZ098, or AMZ099	Standard Steel Property (ECSI 1076) Wirfs Property (ECSI 2424) Trumbull Asphalt Plant (ECSI 1160) City of Portland Outfalls (ECSI 2425; City Street Runoff) ODOT (ECSI 5437; Highway 30 Road Runoff)	--	--	--	RM9W Driver COCs	Single Event; January 2021 ~~January through October 2021 (3 Periods)~~	Manual Grab[1] ~~In-line Sediment Trap[2]~~
OF-18 East-Central Subbasin	AAX318	AAX278		--	--	--	RM9W Driver COCs	Single Event; January 2021	Manual Grab[1]
	AAX261	N/A	Pennzoil Container Management Services (ECSI 4784) Carson Oil Co., Inc. (ECSI 1405) ANRFS Holdings, Inc. (ECSI 1820) City of Portland Outfalls (ECSI 2425; City Street Runoff)	--	--	--	RM9W Driver COCs	Single Event; January 2021	Manual Grab[1]
	AAT557	AMZ098 or AMZ099	Pennzoil Container Management Services (ECSI 4784) Carson Oil Co., Inc. (ECSI 1405) ANRFS Holdings, Inc. (ECSI 1820) Univar (ECSI 330)	--	--	--	RM9W Driver COCs	Single Event; January 2021 ~~January through October 2021 (3 Periods)~~	Manual Grab[1] ~~In-line Sediment Trap[2]~~
OF-18 West-Central Subbasin	AAX381	N/A	Lawrence Clyde & Son Container Management Services (ECSI 4784) Wilhelm Trucking (ECSI 69) City of Portland Outfalls (ECSI 2425; City Street Runoff)	--	--	--	RM9W Driver COCs	Single Event; January 2021	Manual Grab[1]
	AAX265	N/A					RM9W Driver COCs	Single Event; January 2021	Manual Grab[1]
	AAX186	N/A	Lawrence Clyde & Son Timberline Equipment Co. A.J. Zinda Co. Rasmussen & Co. National Pitch Products Corp City of Portland Outfalls (ECSI 2425; City Street Runoff)	--	--	--	RM9W Driver COCs	Single Event; January 2021	Manual Grab[1]
	AAT466	AAT470 and AMZ085	Lawrence Clyde & Son Container Management Services (ECSI 4784) Wilhelm Trucking (ECSI 69) Timberline Equipment Co. A.J. Zinda Co. Rasmussen & Co. National Pitch Products Corp	--	--	--	RM9W Driver COCs	Single Event; January 2021	Manual Grab[1]

Table 2 *(continued)*

Outfall Basin	Manhole Sample Locations	Potential Alternative Sample Locations	B and C-Status Properties within Drainage Sub-Basin[5]	Sample Media and Proposed Analytical Suite					
				Storm Water			Storm Water Solids		
				Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Sample Collection Method(s)
			Texaco City of Portland Outfalls (ECSI 2425; City Street Runoff)					~~January through October 2021 (3 Periods)~~	~~In-line Sediment Trap[2]~~
OF-18 Western Subbasin	AND535	AND534, AAT495, and AMZ085	City of Portland Outfalls (ECSI 2425; City Street Runoff)	--	--	--	RM9W Driver COCs	Single Event; January 2021	Manual Grab[1]
								~~January through October 2021 (3 Periods)~~	~~In-line Sediment Trap[2]~~
OF-18 Downstream Subbasin	AMZ094	N/A	Standard Steel Property (ECSI 1076) Wirfs Property (ECSI 2424) Trumbull Asphalt Plant (ECSI 1160) Pennzoil Container Management Services (ECSI 4784) Carson Oil Co., Inc. (ECSI 1405) ANRFS Holdings, Inc. (ECSI 1820) Univar (ECSI 330) Lawrence Clyde & Son Wilhelm Trucking (ECSI 69) Timberline Equipment Co. A.J. Zinda Co. Rasmussen & Co.	~~--~~	~~--~~	~~--~~	~~RM9W RPCs~~	~~Single Event; January 2021~~	~~Manual Grab~~
				RM9W Driver COCs	January through October 2021 (3 Storm Events)	High volume sampling (HVS) system	RM9W RPCs	January through October 2021 (3 Storm Events)	High volume sampling (HVS) system[3]
				~~--~~	~~January through October 2021 (Continuous)~~	~~Flow Meter~~	~~RM9W RPCs~~	~~January through October 2021 (3 Periods)~~	~~In-line Sediment Traps~~
OF-18 Downstream Subbasin	AMZ087	N/A	Standard Steel Property (ECSI 1076) Wirfs Property (ECSI 2424) Trumbull Asphalt Plant (ECSI 1160) Pennzoil Container Management Services (ECSI 4784) Carson Oil Co., Inc. (ECSI 1405) ANRFS Holdings, Inc. (ECSI 1820)	--	--	--	RM9W RPCs	Single Event; January 2021	Manual Grab[1]
				--	January through October 2021 (Continuous)	Flow Meter	RM9W RPCs	January through October 2021 (3 Periods)	In-line Sediment Trap[2]
City Outfall Basin 18	OF-18	N/A	All Upland Industrial Sites within City OF Basin 18	--	--	--	RM9W RPCs	Single Event (Low Water; September 2021)	3-Point Composite Manual Grab[4] (September 2021)

Table 2 *(continued)*

Outfall Basin	Manhole Sample Locations	Potential Alternative Sample Locations	B and C-Status Properties within Drainage Sub-Basin[5]	Sample Media and Proposed Analytical Suite: Storm Water: Analyte List	Storm Water: Sample Frequency	Storm Water: Collection Method	Storm Water Solids: Analyte List	Storm Water Solids: Sample Frequency	Storm Water Solids: Sample Collection Method(s)
City Outfall Basin 19 Sampling Locations									
OF-19	AAT497	N/A	PGE Forest Park (ECSI 2246) City of Portland Outfalls (ECSI 2425; City Street Runoff)	--	--	--	RM9W Driver COCs	Single Event; January 2021	Manual Grab[1]
	~~ANB317~~ AMZ076	AAT496	ODOT (ECSI 5437; Highway 30 Road Runoff)	--	--	--	RM9W Driver COCs	Single Event; January 2021	Manual Grab[1]
	~~AAP931~~	N/A	~~PGE Forest Park (ECSI 2246)~~ ~~ODOT (ECSI 5437; Highway 30/St. Helens Road Runoff)~~ ~~City of Portland Outfalls (ECSI 2425; City Street Runoff)~~	~~–~~	~~–~~	~~–~~	~~RM9W Driver COCs~~	~~Single Event; January 2021~~	~~Manual Grab~~
								~~January through October 2021 (3 Periods)~~	~~In-line Sediment Traps~~
	AAP913	N/A	Conoco Philips (ECSI 177) Tube Forgings (ECSI 1239) ODOT (ECSI 5437; Highway 30/St. Helens Road Runoff) City of Portland Outfalls (ECSI 2425; City Street Runoff)	--	--	Flow Meter	RM9W ~~Driver COCs~~ RPC	Single Event; January 2021	Manual Grab[1]
								January through October 2021 (3 Periods)	In-line Sediment Trap[2]
	~~AAP918~~	N/A	~~Conoco Philips (ECSI 177)~~ ~~Tube Forgings (ECSI 1239)~~ ~~PGE Forest Park (ECSI 2246)~~ ~~ODOT (ECSI 5437; Highway 30/St. Helens Road Runoff)~~ ~~City of Portland Outfalls (ECSI 2425; City Street Runoff)~~	~~–~~	~~–~~	~~–~~	~~RM9W RPCs~~	~~Single Event; January 2021~~	~~Manual Grab~~
				~~RM9W Driver COCs~~	~~January through October 2021 (3 Storm Events)~~	~~High volume sampling (HVS) system~~	~~RM9W Driver COCs~~	~~January through October 2021 (3 Storm Events)~~	~~High volume sampling (HVS) system~~
				~~–~~	~~January through October 2021 (Continuous)~~	~~Flow Meter~~	~~RM9W RPCs~~	~~January through October 2021 (3 Periods)~~	~~In-line Sediment Traps~~

Table 2 ***(continued)***

Outfall Basin	Manhole Sample Locations	Potential Alternative Sample Locations	B and C-Status Properties within Drainage Sub-Basin[5]	Sample Media and Proposed Analytical Suite: Storm Water: Analyte List	Storm Water: Sample Frequency	Storm Water: Collection Method	Storm Water Solids: Analyte List	Storm Water Solids: Sample Frequency	Storm Water Solids: Sample Collection Method(s)
	AAP929	AAP939	Conoco Philips (ECSI 177) Tube Forgings (ECSI 1239) PGE Forest Park (ECSI 2246) ODOT (ECSI 5437; Highway 30/St. Helens Road Runoff) City of Portland Outfalls (ECSI 2425; City Street Runoff) PGE Forest Park (ECSI 2246) ODOT (ECSI 5437; Highway 30/St. Helens Road Runoff)	--	--	--	RM9W RPCs	Single Event; January 2021	Manual Grab[1]
				--	January through October 2021 (Continuous)	Flow Meter	RM9W RPCs	January through October 2021 (3 Periods)	In-line Sediment Trap[2]
	~~AAP918~~ AAP904	AAP918	Conoco Philips (ECSI 177) Tube Forgings (ECSI 1239) PGE Forest Park (ECSI 2246) ODOT (ECSI 5437; Highway 30/St. Helens Road Runoff) City of Portland Outfalls (ECSI 2425; City Street Runoff) PGE Forest Park (ECSI 2246) ODOT (ECSI 5437; Highway 30/St. Helens Road Runoff) City of Portland Outfalls (ECSI 2425; City Street Runoff)	RM9W Driver COCs	January through October 2021 (3 Storm Events)	High volume sampling (HVS) system	RM9W Driver COCs	January through October 2021 (3 Storm Events)	High volume sampling (HVS) system[3]
City Outfall Basin 19A Sampling Locations									
OF-19A	AAP905	N/A	City of Portland Outfalls (ECSI 2425; Runoff from City Streets and adjacent properties)	--	--	--	RM9W RPCs	Single Event; January 2021	Manual Grab[1]
				RM9W Driver COCs	January through October 2021 (3 Storm Events)	High volume sampling (HVS) system	RM9W Driver COCs	January through October 2021 (3 Storm Events)	High volume sampling (HVS) system[3]
				--	January through October 2021 (Continuous)	Flow Meter	RM9W RPCs	January through October 2021 (3 Periods)	In-line Sediment Trap[2]
~~*Sites with potential ongoing contamination directly to the RM9W Project Area*~~									
~~Gunderson, Inc.~~	~~WR-138~~		~~Gunderson, Inc. (ECSI 1155)~~	~~--~~	~~--~~	~~--~~	~~RM9W RPCs~~	~~Single Event; January 2021~~	~~Manual Grab~~

Table 2 *(continued)*

Outfall Basin	Manhole Sample Locations	Potential Alternative Sample Locations	B and C-Status Properties within Drainage Sub-Basin[5]	Sample Media and Proposed Analytical Suite					
				Storm Water			Storm Water Solids		
				Analyte List	Sample Frequency	Collection Method	Analyte List	Sample Frequency	Sample Collection Method(s)
~~Front LP Properties~~	~~C-5 from Tube Forgings of America~~		~~Tube Forgings (Part of Front LP Properties; ECSI 1239)~~ ~~Glacier Northwest Inc. (ECSI 2378)~~	–	–	–	~~RM9W Driver COCs~~	~~Single Event; January 2021~~	~~Manual Grab~~
	~~SW-1 from Glacier Northwest Inc.~~			–	–	–	~~RM9W Driver COCs~~	~~Single Event; January 2021~~	~~Manual Grab~~
	~~Manhole Upstream from WR-7~~			–	–	–	~~RM9W RPCs~~	~~Single Event; January 2021~~	~~Manual Grab~~

Notes:
COC = Contaminant of Concern
ECSI = Environmental Cleanup Site Information
ODOT = Oregon Department of Transportation
OF = Outfall
RM9W = River Mile 9 West
RPC = Recontamination Potential Chemical
[1]Manual stormwater solid grab samples will be collected at time of entry as long as a minimum of 8-oz of solids are present. If less then 8-oz of solids are present, then the manual grab sample location shall be abandoned and alternative locations will be inspected and one will
[2]The in-line sediment trap design that is similar to that utilized in the EPA-approved Round 3A Stormwater Field Sampling Plan, Portland Harbor RI/FS (LWG, 2007). But instead of deploying just two bottles per location, four 1 liter bottles will be secured in place using
[3]The high-volume sampling (HVS) system sampling methodology includes pumping storm water at a consistent rate over the duration of the storm and running high-volumes of water through the HVS system to distinguish between the dissolved and solids fractions. Additional
[4]Three-point manual grab samples of surface sediment will be collected by Foth at low river stage in September of 2021. Additional detail is provided in Section 2.2.3 of the Field Sampling Plan (FSP) and referenced SOPs.

Table 3

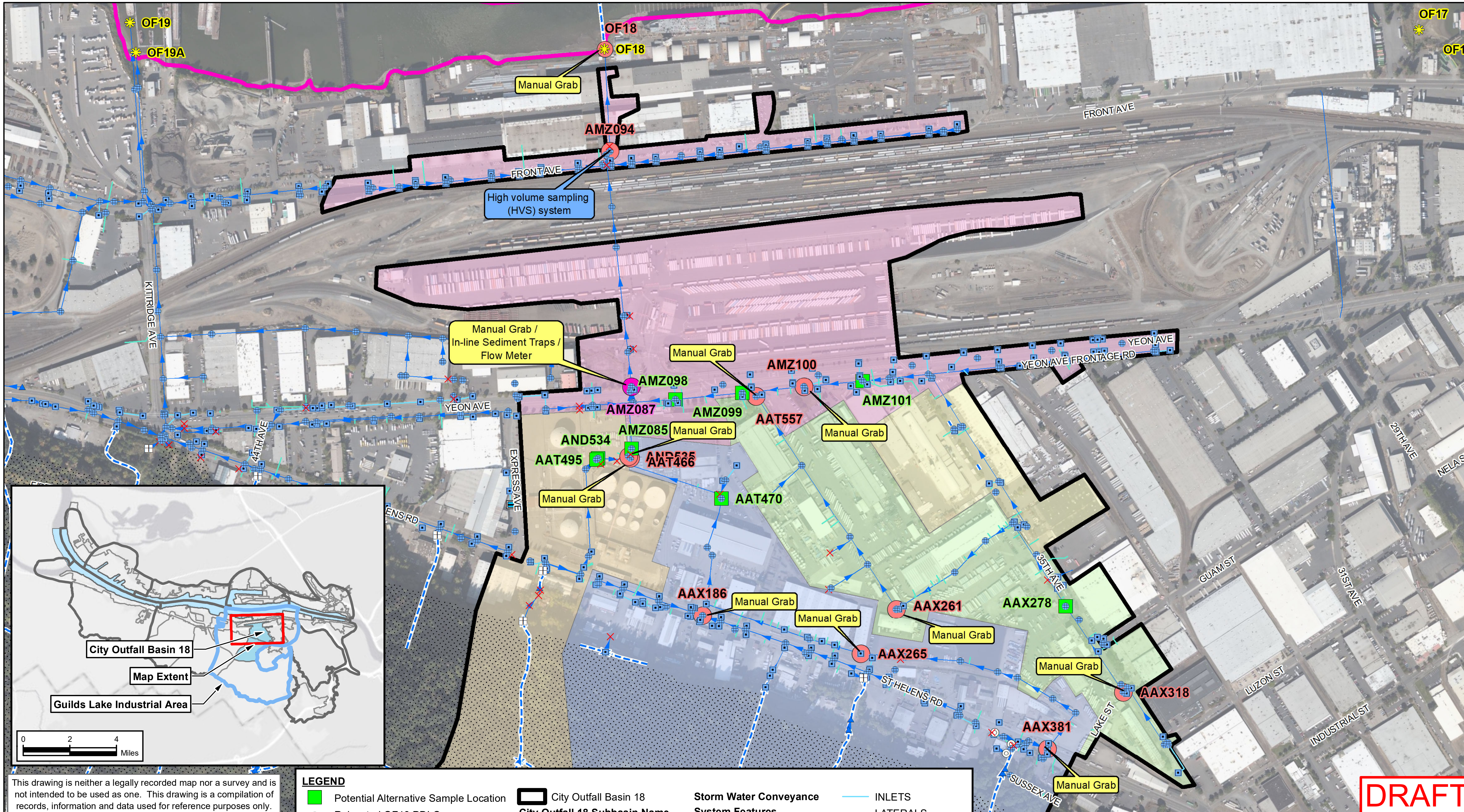
Container Management Services Site Sampling Locations and Analytical Approach

Sample Locations	Sample Media	Analytical Approach		
		Analyte List	Sample Frequency	Collection Method[1]
Container Management Services (ECSI 4784)				
Unpaved areas within Railroad ROW east of CMS SW-6	Surface and Near Surface Soil	RM9W RPCs	Single Event; January 2021	5-Point Composite Manual Grab
Unpaved areas within Railroad ROW adjacent to CMS MH-2	Surface and Near Surface Soil	RM9W RPCs	Single Event; January 2021	5-Point Composite Manual Grab
Unpaved areas within Railroad ROW northeast of CMS MH-4	Surface and Near Surface Soil	RM9W RPCs	Single Event; January 2021	5-Point Composite Manual Grab
Unpaved areas of Lake Street south of railroad and southwest of CMS facility	Surface and Near Surface Soil	RM9W RPCs	Single Event; January 2021	5-Point Composite Manual Grab

Abbreviations:
COI = Contaminants of Interest
ECSI = Environmental Cleanup Site Information
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RM9W = River Mile 9 West
ROW = Right of Way
RPC = Recontamination Potential Chemical
TPH = total petroleum hydrocarbons

Prepared by: ECH
Checked by: KMC2
Revised 12/21/2020: AVB
Checked by: ECH

Figures



This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

NOTES:
1. Horizontal Coordinate System: NAD 1983 State Plane Oregon North Ft Intl.
2. Imagery supplied by esri and its data suppliers.
3. The river miles and RM9W Project Area limits were supplied by USEPA, January 2020.
4. Current basin areas were provided by the City of Portland in April 2020.
5. Outfalls and ECSI Areas supplied by ODEQ, January 2020.
6. Source control sufficiency status rankings assigned by FMC.

LEGEND

- Potential Alternative Sample Location
- Relocated OF18 PDI Conveyance System Sample Location
- OF18 PDI Conveyance System Sample Location
- Solids Samples Type
- Water Samples Type
- City Outfall Basin 18

City Outfall 18 Subbasin Name
- Downstream Subbasin
- East-Central Subbasin
- Eastern Subbasin
- West-Central Subbasin
- Western Subbasin
- City Outfall Basin - Forested

Storm Water Conveyance System Features
- MANHOLES
- CLEANOUTS
- DISCHARGE POINTS
- INLETS
- NO ACCESS POINTS
- OUTFALL
- SUMPS
- TRASH RACK
- INLETS
- LATERALS
- STORM PIPES
- SURFACE WATER
- City Outfalls
- RM9W Project Area

N

Foth

0 250 500 Feet

FMC

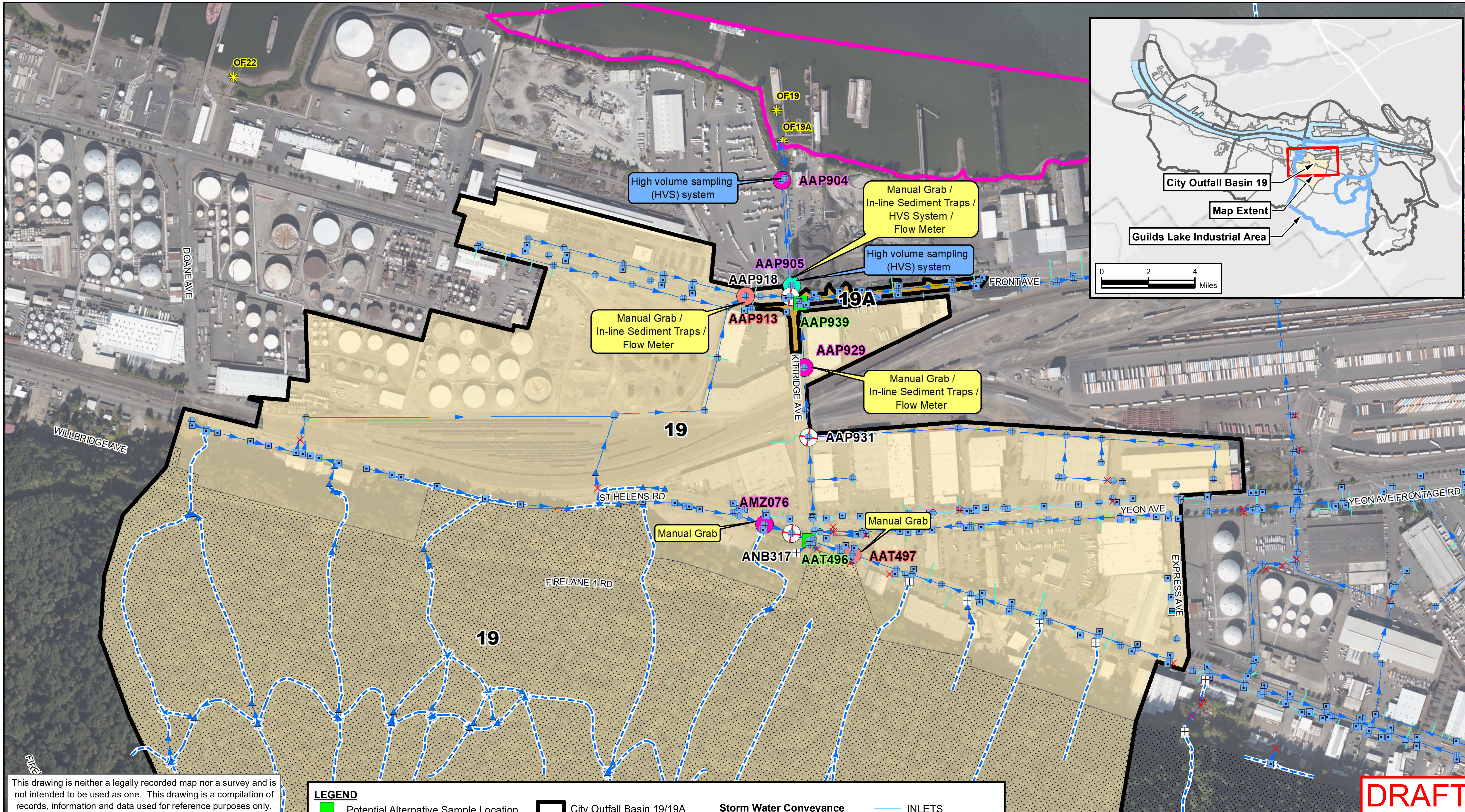
FIGURE 1

PROPOSED CITY OUTFALL BASIN 18 CONVEYANCE SYSTEM SAMPLING LOCATIONS

RIVER MILE 9 WEST

Date: OCTOBER 2020	Revision Date: DECEMBER 2020	
Drawn By: DAT	Checked By: ECH1	Project:18F008

Path: Q:\FMC\18F008\GIS\mxd\Storm Water Sampling Memo\Figure 1 - City Outfall Basin 18 Conveyance System Sampling Locations.mxd Date: 1/11/2021



NOTES:

1. Horizontal Coordinate System: NAD 1983 State Plane Oregon North Ft Intl.
2. Imagery supplied by esri and its data suppliers.
3. The river miles and RM9W Project Area limits were supplied by USEPA, January 2020.
4. Current basin areas were provided by the City of Portland in April 2020.
5. Outfalls and ECSI Areas supplied by ODEQ, January 2020.
6. Source control sufficiency status rankings assigned by FMC.

LEGEND

- Potential Alternative Sample Location
- Removed PDI Conveyance System Sample Location
- Relocated OF18 PDI Conveyance System Sample Location
- OF19A PDI Conveyance System Sample Location
- OF19 PDI Conveyance System Sample Location
- City Outfall Basin 19/19A

Storm Water Features

- City Outfall Basin 19
- City Outfall Basin 19A
- City Outfall Basin - Forested
- Solids Samples Type
- Water Samples Type

Storm Water Conveyance System Features

- MANHOLES
- DISCHARGE POINTS
- INLETS
- NO ACCESS POINTS
- OUTFALL
- SUMPS
- TRASH RACK
- INLETS
- LATERALS
- STORM PIPES
- SURFACE WATER
- City Outfalls
- RM9W Project Area

N

0 250 500 Feet

Foth

FMC

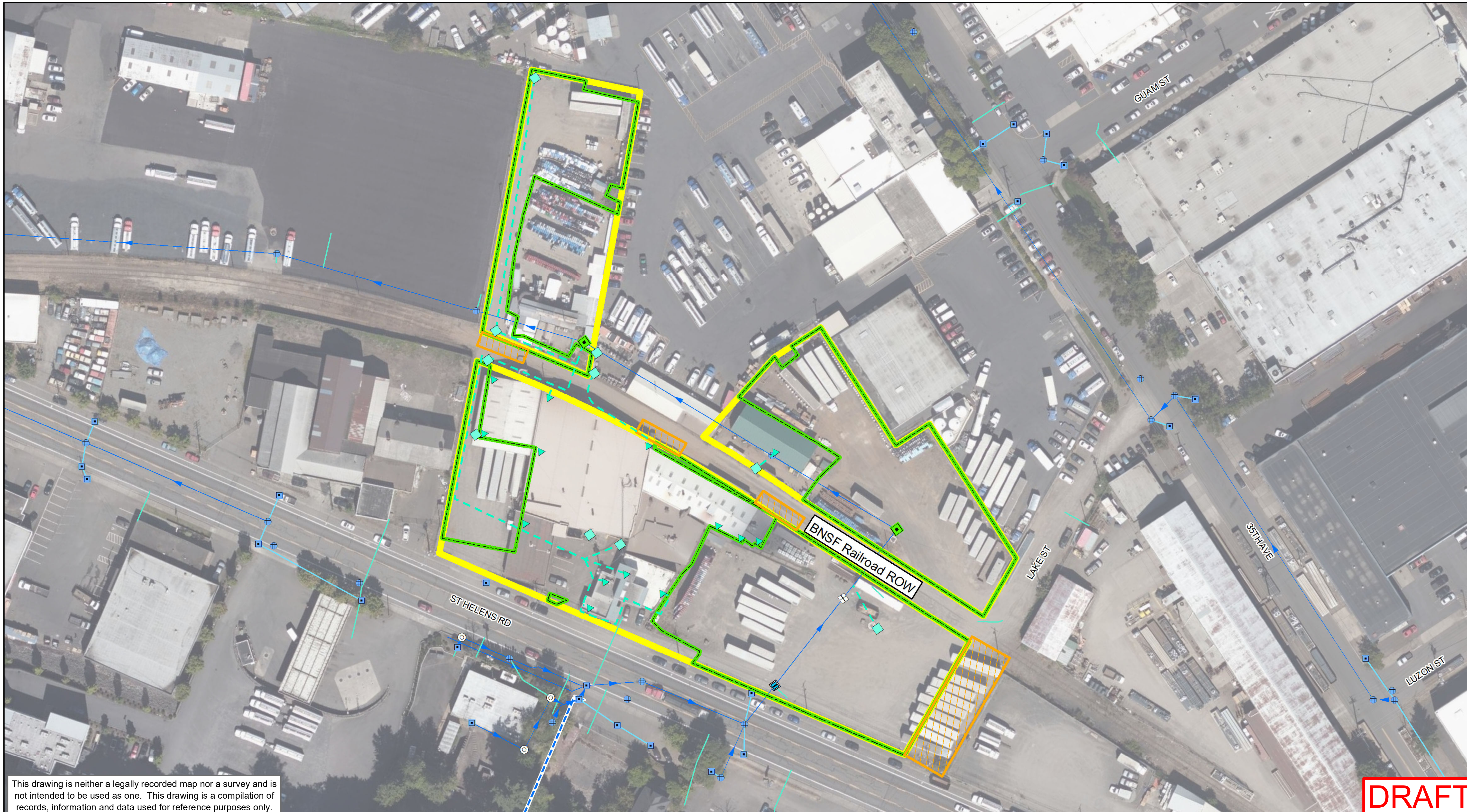
FIGURE 2

PROPOSED CITY OUTFALL BASINS 19 AND 19A CONVEYANCE SYSTEM SAMPLING LOCATIONS

RIVER MILE 9 WEST

Date: OCTOBER 2020	Revision Date: DECEMBER 2020	
Drawn By: DAT	Checked By: ECH1	Project:18F008

Path: Q:\FMC\18F008\GIS\mxd\Storm Water Sampling Memo\Figure 2 - City Outfall Basin 19 Conveyance System Sampling Locations.mxd Date: 1/11/2021



NOTES:
1. Horizontal Coordinate System: NAD 1983 State Plane Oregon North Ft Intl.
2. Imagery supplied by esri and its data suppliers.
3. Private stormwater features were digitized off of SLR Figure 2 of the Upland Priority Sampling Location Report (Project No. 117.00973.00005) Locations are approximate.

LEGEND

- Container Management Services Site Boundary (ECSI 4784)
- Approximate Pervious Area
- 5-Point Composite Sample Area

Private Storm Water Features [3]

- Access Vault
- Catch Basin
- Concrete Vault
- Over Flow Box
- Roof Drain
- Approximate Private Stormwater Piping

City Storm Water Features

- MANHOLES
- CLEANOUTS
- INLETS
- INLETS
- LATERALS
- STORM PIPES
- SURFACE WATER

N

Foth

0 45 90 Feet

FMC

FIGURE 3
PROPOSED CONTAINER MANAGEMENT SERVICES (ECSI 4784) SAMPLING LOCATIONS
FIELD SAMPLING PLAN
RIVER MILE 9 WEST

Date: OCTOBER 2020	Revision Date: DECEMBER 2020
Drawn By: DAT	Checked By: ECH1 / Project:18F008

Path: Q:\FMC\18F008\GIS\mxd\Storm Water Sampling Memo\Figure 3 - Proposed Container Management Services (ECSI 4784) Sampling Locations.mxd Date: 1/11/2021

Attachment 1

Technical Memorandum: River Mile 9 West (RM9W) Upland Area Storm Water Field Reconnaissance Findings to USEPA (January 15, 2021)

Foth Infrastructure & Environment, LLC

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(920) 497-2500 • Fax: (920) 497-8516
www.foth.com

Memorandum

January 15, 2021

TO: Josie Clark (USEPA)

CC: Christina Moretti (FMC), Jennifer Jones (CDM Smith)

FR: Erin Hughes (Foth)

RE: River Mile 9 West (RM9W) Upland Area Storm Water Field Reconnaissance Findings

On December 30, 2019, FMC Corporation (FMC) and the U.S. Environmental Protection Agency (USEPA) voluntarily entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) (USEPA, 2019), to perform remedial design (RD) work within the River Mile 9 West (RM9W) Project Area of the Portland Harbor Superfund Site (PHSS), and the work described in this technical memorandum (memo) was performed in accordance with the ASAOC. This memo presents the findings of the December 7, 2020 Storm Water Outfall and Conveyance system field reconnaissance task performed by Foth Infrastructure & Environment, LLC (Foth) and Apex Companies LLC (Apex), as described in a virtual meeting with stakeholders held on November 13, 2020 and as outlined in Section 1.4, Phase 1, Task 1 'Storm Water Outfall and Conveyance System Sampling' of the *Field Sampling Plan* (*FSP*), Appendix B to the RM9W *Pre-Design Investigation Work Plan (PDI Work Plan)* (Foth, 2020a). The reconnaissance task was completed in accordance with the *Quality Assurance Project Plan (QAPP)* (Foth, 2020b), and *Health and Safety Plan (HASP)* (Foth, 2020c), Appendices A and C to the *PDI Work Plan*, respectively.

On December 7, 2020, under City Bureau of Environmental Services (BES) system Access Authorization (November 11, 2020), Apex, under oversight of Foth, conducted a field reconnaissance of storm water and storm water solids sampling locations proposed in Task 1, of the Draft *PDI Work Plan*, submitted to the USEPA, on October 26, 2020. The proposed sample locations are shown on Figures 5 and 6, of the *FSP*, and are provided as Attachment 1, for reference.

The site reconnaissance was performed to assess the feasibility of accessing the proposed sample locations in advance of the sampling activities expected to begin in early 2021. During the reconnaissance, an Apex technician visually inspected accessible manholes and outfalls. A record of site conditions and a photographic log was developed for each proposed location. Sample locations were inspected for accessibility, such as requirements for confined space entry, traffic control and associated planning needs, private property restrictions, and for the presence/degree of accumulated solids and estimated water level. This information was used to inform the final sampling plan. A photographic log of the proposed sample locations that were inspected during the field reconnaissance is provided as Attachment 2. Field reconnaissance notes for each sample location are presented in Table 1, which is provided in Attachment 3. Sample locations are depicted on Figures 5 and 6 attached to this memo.

In general, the proposed locations were considered favorable for the sampling activities outlined in the *PDI Work Plan* and *FSP*, with the exception of those sample locations discussed below:

- **AAX318**, **ANB317, and AAP931** – These manholes were not observed at the presumed locations.

- **AAP918** – The Apex field team encountered a City BES flow meter/HACH ISCO sampler blocking vault access and obscuring view of the pipe.

- **AMZ100 and AAT557** – No accumulated solids were observed within the conveyance system at these locations, limiting manual grab sample collection.

Several manholes were not accessed during field reconnaissance due to their location in a public street right-of-way or being otherwise visible but blocked from access including AAX381, AAX186, AND535, AAT497, ANB317, and AAP931. Traffic control procedures will be implemented during sampling for any locations identified within a public street right-of-way. Changes to the scope of work as a result of the site recon will be included in the final *PDI Work Plan*.

References

U.S. Environmental Protection Agency, 2019a. *Administrative Settlement Agreement and Order on Consent for Remedial Design at River Mile 9 West Project Area.* CERCLA Docket No. 10-2020-0038, Region 10. December 20, 2019.

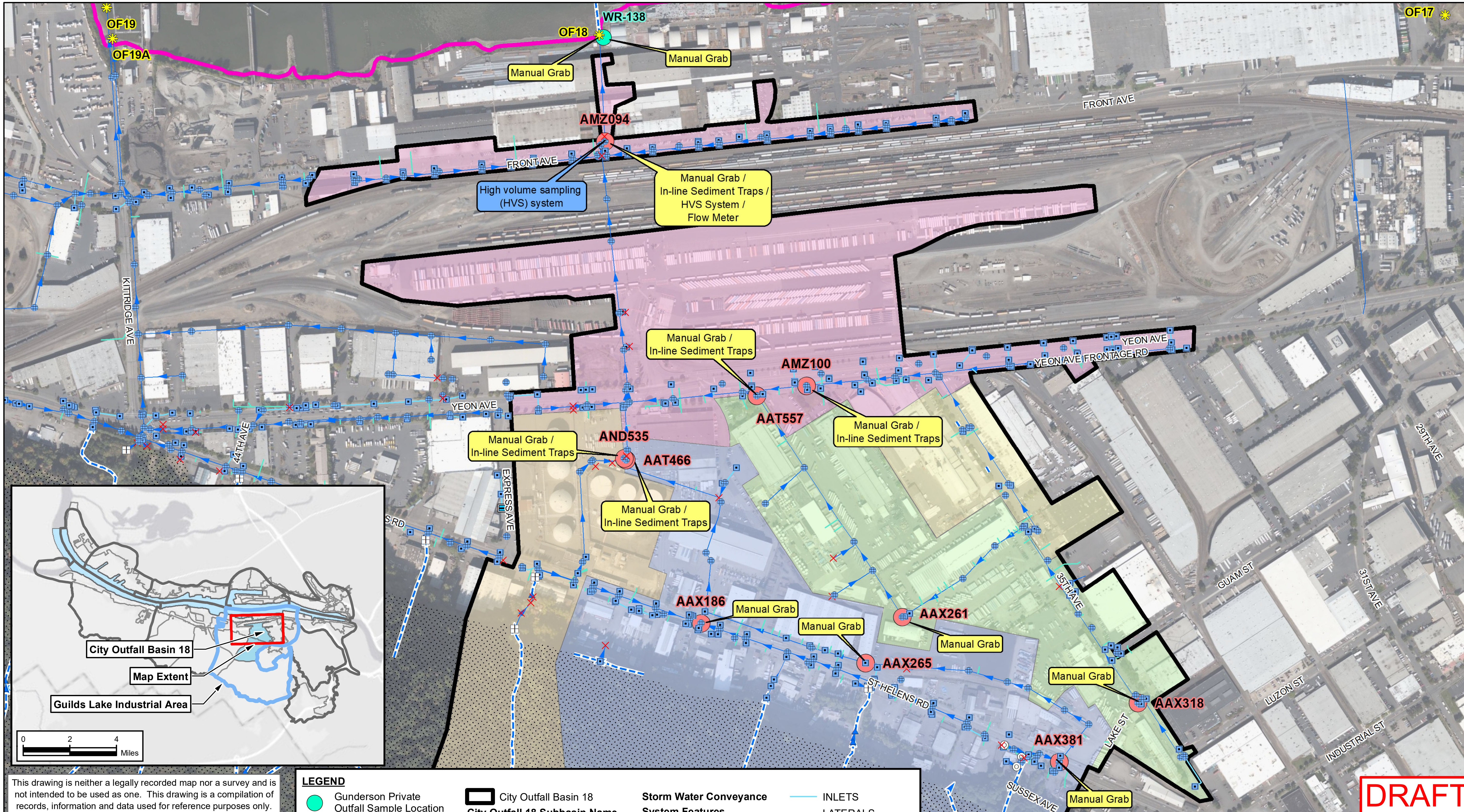
Foth Infrastructure & Environment, LLC, 2020a. *Pre-Design Investigation Work Plan*. October 2020.

Foth Infrastructure & Environment, LLC, 2020b. *Quality Assurance Project Plan*. October 2020.

Foth Infrastructure & Environment, LLC, 2020c. *Health and Safety Plan*. October 2020.

Attachment 1

Figures 5 and 6 of the Field Sampling Plan



This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

NOTES:

1. Horizontal Coordinate System: NAD 1983 State Plane Oregon North Ft Intl.
2. Imagery supplied by esri and its data suppliers.
3. The river miles and RM9W Project Area limits were supplied by USEPA, January 2020.
4. Current basin areas were provided by the City of Portland in April 2020.
5. Outfalls and ECSI Areas supplied by ODEQ, January 2020.
6. Source control sufficiency status rankings assigned by FMC.

LEGEND

- Gunderson Private Outfall Sample Location
- OF18 PDI Conveyance System Sample Locations
- Solids Samples Type
- Water Samples Type

- City Outfall Basin 18

City Outfall 18 Subbasin Name

- Downstream Subbasin
- East-Central Subbasin
- Eastern Subbasin
- West-Central Subbasin
- Western Subbasin
- City Outfall Basin - Forested

Storm Water Conveyance System Features

- MANHOLES
- CLEANOUTS
- DISCHARGE POINTS
- INLETS
- NO ACCESS POINTS
- OUTFALL
- SUMPS
- TRASH RACK

- INLETS
- LATERALS
- STORM PIPES
- SURFACE WATER
- City Outfalls
- RM9W Project Area

N

Foth

0 250 500 Feet

FMC

FIGURE 5

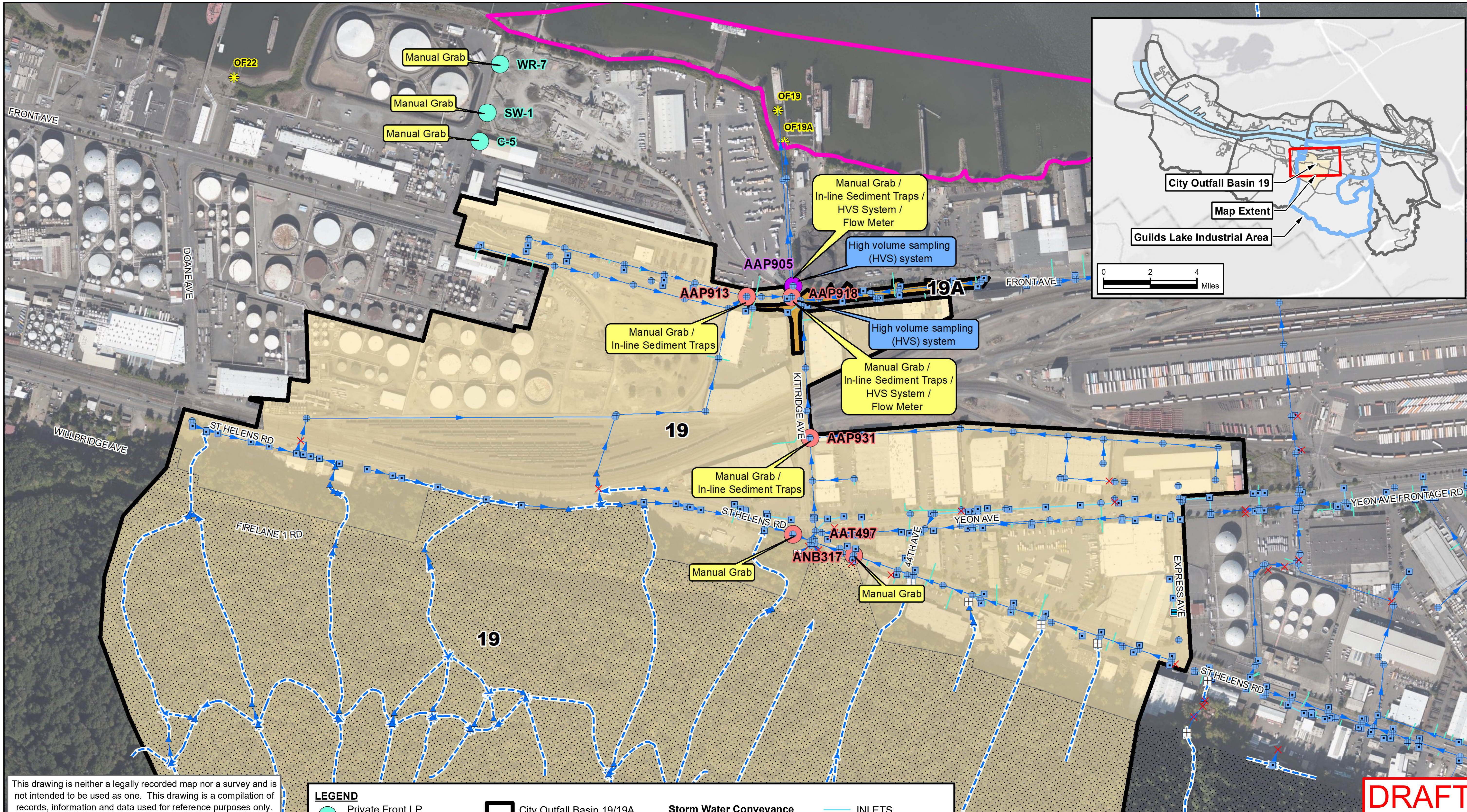
PROPOSED CITY OUTFALL BASIN 18 AND GUNDERSON, INC. CONVEYANCE SYSTEM SAMPLING LOCATIONS

FIELD SAMPLING PLAN

RIVER MILE 9 WEST

Date: OCTOBER 2020	Revision Date:	
Drawn By: DAT	Checked By: ECH1	Project:18F008

Path: Q:\FMC\18F008\GIS\mxd\PDI Work Plan\FSP\Figure 5 - City Outfall Basin 18 Conveyance System Sampling Locations.mxd Date: 10/12/2020



This drawing is neither a legally recorded map nor a survey and is not intended to be used as one. This drawing is a compilation of records, information and data used for reference purposes only.

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4. Current basin areas were provided by the City of Portland in April 2020.
5. Outfalls and ECSI Areas supplied by ODEQ, January 2020.
6. Source control sufficiency status rankings assigned by FMC.

LEGEND

- Private Front LP Outfall Sample Location
- OF19A PDI Conveyance System Sample Locations
- OF19 PDI Conveyance System Sample Locations
- Solids Samples Type
- Water Samples Type
- City Outfall Basin 19/19A

Storm Water Features

- City Outfall Basin 19
- City Outfall Basin 19A
- City Outfall Basin - Forested

Storm Water Conveyance System Features

- MANHOLES
- DISCHARGE POINTS
- INLETS
- NO ACCESS POINTS
- OUTFALL
- SUMPS
- TRASH RACK
- INLETS
- LATERALS
- STORM PIPES
- SURFACE WATER
- City Outfalls
- RM9W Project Area

N

Foth

0 250 500 Feet

FMC

FIGURE 6
PROPOSED CITY OUTFALL BASINS 19 AND 19A AND FRONT LP PROPERTIES CONVEYANCE SYSTEM SAMPLING LOCATIONS
FIELD SAMPLING PLAN
RIVER MILE 9 WEST

Date: OCTOBER 2020	Revision Date:	
Drawn By: DAT	Checked By: ECH1	Project:18F008

Path: Q:\FMC\18F008\GIS\mxd\PDI Work Plan\FSP\Figure 6 - City Outfall Basin 19 Conveyance System Sampling Locations.mxd Date: 10/12/2020

Attachment 2

Photographic Log of the Proposed Sample Locations

Photograph 1

Description: Proposed sample type: WR-138 - Manual Grab; OF-18 – three-point composite grab. Photo taken from top of riverbank at Gunderson looking down riprap slope to Willamette River. WR-138 (8-inch steel pipe, possibly corrugated) in foreground was not accessible during the recon. WR-138 outfall is approximately 10 feet down steep riprap slope. Outfall OF-18 in background, will be accessed via boat in September 2021 in coordination with in-river sampling activities.

Photograph 2

Description: AMZ094 Proposed sample type - Manual grab, HVS, and in-line sediment trap. Approx 20 ft depth, adequate sediment for sampling, flow approximately 20 gpm. Confined space entry will be required for flow meter, in-line sediment traps, and manual sediment sample collection tasks.

Photograph 3

Description: Access for Manhole AMZ094. No traffic control plan required, located in Gunderson parking lot.

Photograph 4 Description:	AAP905 Proposed sample type - Manual grab, flow meter, in-line sediment trap and HVS. 20' depth, very limited sediment, water present but not flowing. Confined space entry will be required for flow meter, in-line sediment traps, and manual sediment sample collection tasks.	
Photograph 5 Description:	AAP905. No traffic control plan required, located in unpaved area.	
Photograph 6 Description:	AAP918 Proposed sample type - Manual grab, flow meter, in-line sediment trap and HVS. Manhole has flow meter and sampler installed. Equipment owned by City of Portland. Unable to determine depth, sediment and water presence due to sampler obstructing view. Sampler and meter must be removed prior to sediment sampling activities. No traffic control plan required for this location. If accessible, confined space entry will be required for flow meter, in-line sediment traps, and manual sediment sample collection tasks.	

Photograph Description:	7 AAP913 Proposed sample type - Manual grab, flow meter, and in-line sediment trap. 15' depth, some sediment and 20 gpm flow. Parking lot location, no traffic control plan required. Confined space entry will be required for flow meter, in-line sediment traps, and manual sediment sample collection tasks.	
Photograph Description:	8 AAT497 Proposed sample type - Manual grab. Middle turn lane on St. Helens road near intersection with Yeon Ave. Unable to safely access during site recon. Location access requires traffic control plan.	

Photograph 9
Description:

AAT497 Note location is in center lane prior to turn only lane. This photo is for traffic control planning.

Photograph 10
Description:

Area of ANB317. Proposed sample type - Manual grab. Unable to locate this manhole. The manhole may be covered with grass.

Photograph 11
Description:

Southbound St Helens Rd near intersection with Yeon Ave. Manhole AMZ147 in the sidewalk is potential alternative for ANB 317. Location access requires pedestrian controls.

Photograph 12 Description:	AAT557 Proposed sample type - Manual grab and in-line sediment trap. No sediment and 30 gpm flow. Confined space entry will be required for in-line sediment traps and manual sediment sample collection tasks.	
Photograph 13 Description:	AAT557 14' deep manhole located on sidewalk in driveway access to private property. Location access requires pedestrian controls.	

Photograph 14
Description:

AMZ100 Proposed sample type - Manual grab and in-line sediment trap. 20' depth, no sediment, trickle flow. Location will require traffic control plan. Confined space entry will be required for in-line sediment traps and manual sediment sample collection tasks.

Photograph 15
Description: AAT466 Proposed sample type - Manual grab and in-line sediment trap. 13.5' depth, limited sediment present, 20 gpm. Confined space entry will be required for in-line sediment traps and manual sediment sample collection tasks.

Photograph 16
Description: AAT466. On private property, no traffic control plan required, but must arrange access and manage framing stick storage. Confined space entry will be required for in-line sediment traps and manual sediment sample collection tasks.

AND535 (no photo shown) Proposed sample type - Manual grab and in-line sediment trap. Unable to access nearby AND535 (presumably covered with framing sticks). Requires same arrangement to manage framing stick storage. Confined space entry will be required for in-line sediment traps and manual sediment sample collection tasks.

Photograph 17
Description:

AAX318 Proposed sample type - Manual grab. Unable to locate AAX318. Potential alternate location for AAX318 in grass ROW near Carson Oil fueling terminal. This location (AAX278 shown highlighted orange in photo) would not require traffic control plan; however, it would require notification/coordination with Carson Oil.

Photograph 18
Description:

AAX381 Proposed sample type - Manual grab. Unable to safely access during site recon. Location access requires traffic control plan.

Photograph 19
Description:

AAX261 Proposed sample type - Manual grab. 10' depth, sediment observed, and 20 gpm flow. On private property in parking lot, no traffic control plan needed. Note that no ladder is present. Confined space entry will be required for manual sediment sample collection tasks.

Photograph 20 Description: AAX186 Proposed sample type - Manual grab. Middle turn lane on St. Helens road. Unable to safely access during site recon. Location access requires traffic control plan.	

Attachment 3

Table 1 – Storm Water Field Reconnaissance Findings

Table 1
Storm Water Field Reconnaissance Findings

Outfall Basin	Manhole Sample Locations	Field Notes	Field Recon Findings: Manhole Accessible for Sampling? Y/N	Confined Space Entry (CSE) Required? Y/N	Solids Observed Y/N	Estimated Water Level/Flow	Traffic Control Needed? Y/N	Proposed Sample Collection Method(s)[1]
City Outfall Basin 18 Sampling Locations								
OF-18 Eastern Subbasin	AMZ100	Located in the middle of business access road adjacent to rail spur (current use unknown) parallel to Yeon Ave. Access is good but will need full traffic control. 20' deep vault in good condition.	Y	Y	N	<1 cm deep, Trickle flow	Y	Manual Grab In-line Sediment Trap
OF-18 East-Central Subbasin	AAX318	Could not locate during recon, will attempt to locate prior to sampling if alternate not available.	N	Unknown	NA	NA	Unknown	Manual Grab
OF-18 East-Central Subbasin	AAX261	Private property (Superior Tank Lines). Good access, newly paved private right of way. 10' deep brick vault (no ladder).	Y	N	Y	20 gpm	N	Manual Grab
OF-18 East-Central Subbasin	AAT557	UNIVAR sidewalk/driveway entrance. 14' deep vault in good condition.	Y	Y	N	30 gpm	N	Manual Grab In-line Sediment Trap
OF-18 West-Central Subbasin	AAX381	Middle turn lane on busy St. Helens Road. Not safe to access during recon without traffic control.	Y	Unknown	NA	NA	Y	Manual Grab
OF-18 West-Central Subbasin	AAX265	Large square grate inlet, no filter, vegetation. Good parking lot access INDUSTRIAL EXPORT CO.	Y	N	Y	Low flow, 10 cm deep	N	Manual Grab
OF-18 West-Central Subbasin	AAX186	Middle turn lane on busy St. Helens Road. Not safe to access during recon without traffic control.	Y	Unknown	NA	NA	Y	Manual Grab
OF-18 West-Central Subbasin	AAT466	Private property (GTS). Although manhole not covered access to location blocked, need to clear area of GTS palleted supplies. Vault 15' deep in good condition.	Y	Unknown	Y	30 gpm	N	Manual Grab In-line Sediment Trap
OF-18 Western Subbasin	AND535	Private property (GTS). Manhole covered and access to location blocked, need to clear area of GTS palleted supplies.	N	Unknown	NA	NA	N	Manual Grab In-line Sediment Trap
OF-18 Downstream Subbasin	AMZ094	Large storm manhole, good access in Gunderson parking lot. Vault 20' deep in good condition.	Y	Y	Y	20 gpm, 10cm deep	N	Manual Grab High volume sampling (HVS) system In-line Sediment Trap
City Outfall Basin 18	OF-18	Steep 30 foot rip-rap bank. Access from water advised. Large (72" estimate) concrete CSO flowing directly to river water level.	NA	NA	NA	NA	NA	3-Point Composite Manual Grab
City Outfall Basin 19 Sampling Locations								
OF-19	AAT497	Middle turn lane on busy St. Helens road near intersection with Yeon Ave. Not safe to access during recon without traffic control.	Y	Unknown	NA	NA	Y	Manual Grab
OF-19	ANB317	Could not locate.	N	Unknown	NA	NA	Unknown	Manual Grab
OF-19	AAP931	Could not locate. Rail road property, area covered in 2" minus gravel adjacent to busy railroad spur and under Kittridge Road bridge.	N	Unknown	NA	NA	Unknown	Manual Grab In-line Sediment Trap
OF-19	AAP913	Good access in Hampton Tree Farms private parking lot. Vault 15' deep in good condition.	Y	Y	Y very limited	21 gpm, 10cm deep	N	Manual Grab In-line Sediment Trap
OF-19	AAP918	Good access off street on grass verge. Already has internal COP BES flow meter/HACH ISCO sampler blocking vault access. Estimated 20' deep vault in good condition.	Y	Y	Obscured	Obscured	N	Manual Grab High volume sampling (HVS) system In-line Sediment Trap
City Outfall Basin 19A Sampling Locations								
OF-19A	AAP905	Good access off street on grass verge. Estimated 20' deep vault in good condition.	Y	Y	Y very limited	No flow but wet	N	Manual Grab High volume sampling (HVS) system In-line Sediment Trap

Prepared by: ECH
Checked by: AVB/SDG

Notes

1. Sample collection method as proposed in October 2020 Draft PDI WP. Subject to revision based on results of reconnaissance survey.

Attachment 2

Storm Drain Sediment Sampling SOP

1. PURPOSE AND SCOPE

The following text describes the techniques that will be employed to collect sediment samples at specified locations. For the purposes of this project, and where necessary, Apex will adopt the FMC Standard OS-8 Permit Required Confined Space Entry (Attachment A).

2. REQUIRED EQUIPMENT

The following equipment and supplies will be used for sediment sample collection:

- Photoionization detectors (PIDs)
- Laboratory-supplied containers
- Decontamination kit (buckets, brushes, Alconox, and tap and deionized water)
- Camera
- Sharpies/pens
- Labels
- Chain-of-Custody forms
- Ice and cooler
- 25-foot grab sample pole with 12-oz. sample cup
- Paper towels
- Personal protective equipment (PPE), including hard hat, boots, high-visibility vest, safety glasses, and nitrile gloves

3. SEDIMENT RETRIEVAL METHODS

The methods for retrieving the accumulated sediment are presented below.

- Using safe lifting techniques, traffic controls (if needed), and implementing all health and safety protocols, open the manhole cover.
- Observe sediment volume present. If the volume is adequate for analytical laboratory requirements (8 oz), proceed with sample collection consistent with this SOP.
- Using a grab sample pole fitted with a sample cup or stainless beaker, collect a representative sample by scooping the sediment from the accumulated location.
- Slowly raise the sample cup to the surface and place the sediment into the laboratory-supplied containers (decant water from top).
- Repeat the procedure until the sample container is filled with sediment.
- Label the sample container.
- Close the manhole cover.
- Decontaminate the sample cup before the next location is sampled.

4. DECONTAMINATION PROCEDURES

Decontamination of sampling equipment must be conducted consistently to ensure the quality of samples collected. Disposable equipment intended for one-time use will not be decontaminated but will be packaged for appropriate disposal.

Decontamination will occur after each use of a piece of equipment between sample locations. All sampling equipment that comes into contact with sampling media (grab pole, stainless beaker, cups, etc.) will be decontaminated according to EPA Region 10 recommended procedures. The following, to be carried out in sequence, is an EPA Region 10 recommended procedure for the decontamination of sampling equipment:

- Non-phosphate detergent and tap water wash, using a brush if necessary
- Tap water rinse
- Deionized/distilled water rinse (first rinse)
- Deionized/distilled water rinse (second rinse)

Equipment will be decontaminated in a predesignated area, and clean bulky equipment items will be stored in their cases or on visqueen in uncontaminated areas. Cleaned small equipment items will be stored in their cases or in plastic bags. Materials to be stored more than a few hours will also be covered.

5. FIELD FORMS

During each site visit to retrieve accumulated sediment, the field crews will complete a field form which will record the following information:

- Name of staff conducting sampling
- Location
- Date/time of sampling
- Presence and approximate depth of any water at the location
- Approximate volume of sediment sampled
- General comments/observations

6. ATTACHMENTS

Attachment A FMC Standard OS-8 Permit Required Confined Space Entry

Attachment B Method 166: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels

1.0 Purpose

1.1 The purpose of this standard is to protect all individuals from hazards associated with entering Permit Required Confined Spaces.

2.0 Scope

2.1 This standard applies at all FMC locations with Permit Required Confined Spaces as defined below. This standard contains requirements for protecting employees and contractors required to enter Permit Required Confined Spaces.

3.0 Definitions

3.1 Acceptable entry conditions: conditions required in a Permit Required Confined Space to allow safe entry by employees or contractors.

3.2 Attendant: individual stationed outside permit spaces who monitors authorized entrants and performs attendant's duties assigned in the FMC's Permit Required Confined Space program.

3.3 Authorized entrant: employee authorized to enter a Permit Required Confined Space.

3.4 Blanking or blinding: absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

3.5 Confined space:

3.5.1 A space large enough and configured so that someone can enter and perform assigned work;

3.5.2 A space that has limited or restricted means for entry or exit; and

3.5.3 A space that is not designed for continuous employee occupancy.

3.6 Double block and bleed: the closure of a line, duct, or pipe by closing and locking two in-line valves and by opening and locking a drain or vent valve in the line between the two closed valves.

3.7 Emergency: any event (including any failure of hazard control or monitoring equipment) internal or external to the Permit Required Confined Space that might endanger entrants.

3.8 Engulfment: surrounding and capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

3.9 Entry: a person passing through an opening into a Permit Required Confined Space. Entry occurs as soon as any part of the body enters an opening into the space.

3.10 Entry permit (permit): document provided by FMC site to allow and control employee or contractor entry into a Permit Required Confined Space.

3.11 Entry supervisor: person responsible for determining whether Permit Required Confined Space conditions are acceptable to allow entry. Entry supervisors are also responsible for overseeing entry operations and for terminating entry when necessary.

Note: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

3.12 Hazardous atmosphere: atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

3.12.1 Flammable gas, vapor, or mist in excess of 10% of its lower flammable limit (LFL);

3.12.2 Airborne combustible dust at a concentration that meets or exceeds its LFL;

Note: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.

3.12.3 Atmospheric oxygen concentration below 19.5% or above 23.5%;

3.12.4 Atmospheric concentration of a toxic substance greater than the Threshold Limit Value (TLV) published in the most recent edition of the American Conference of Governmental industrial Hygienist (ACGIH) TLV booklet or the government regulatory exposure limit published for the country in which the Permit Required Confined Space is located, whichever is lower. That is, toxic and/or hazardous substances at atmospheric concentrations, which could result in employee exposure to greater than the specific substances threshold limit value or permissible exposure limit;

Note: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.

3.12.5 Any other atmospheric condition that is immediately dangerous to life or health.

3.13 Hot work permit: written approval method to perform operations capable of becoming a source of ignition.

3.14 Immediately dangerous to life or health (IDLH): condition posing threat to life, would cause irreversible adverse health effects, or would interfere with an individual's ability to escape unaided from a Permit Required Confined Space.

3.15 Inerting: displacement of atmospheric oxygen in a Permit Required Confined Space by a noncombustible gas (such as nitrogen) such that the resulting atmosphere is noncombustible.

Note: This method of inerting produces an IDLH oxygen-deficient atmosphere.

3.16 Isolation: process by which the potential for energy or material is prevented from entering a confined space. The confined space is completely protected from previous connections to hazardous energy or material sources by: 1) blanking or blinding; 2) misaligning or removing sections of lines, pipes, or ducts; 3) a double block and bleed system; 4) lockout or tagout of all sources of energy; or 5) blocking or disconnecting all mechanical linkages.

3.17 Line breaking: intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

3.18 Non-permit confined space: confined space that does not contain or have potential to contain any hazards capable of causing death or serious physical harm.

3.19 Oxygen deficient atmosphere: atmosphere containing less than 19.5% oxygen by volume.

3.20 Oxygen enriched atmosphere: atmosphere containing more than 23.5% oxygen by volume.

3.21 Permit-required confined space: confined space with one or more of the following characteristics:

3.21.1 Contains or has a potential to contain a hazardous atmosphere;

3.21.2 Contains a material that has the potential for engulfing an entrant;

3.21.3 Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

3.21.4 Contains any other recognized serious safety or health hazard.

3.22 Permit-required confined space program: program for identifying, controlling, and, protecting employees from hazards they may encounter in Permit Required Confined Spaces.

3.23 Permit system: written procedure for preparing and issuing permits for entry into a Permit Required Confined Space.

3.24 Prohibited condition: any condition in a Permit Required Confined Space not allowed by the permit during the period when entry is authorized.

3.25 Rescue service: personnel designated to rescue employees from Permit Required Confined Spaces.

3.26 Retrieval system: equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

3.27 Testing: process by which hazards that may confront entrants of a permit space are identified and evaluated, including specifying tests to be performed in permit space.

Note: Testing enables FMC to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

4.0 Evaluating spaces and signage

4.1 Each site shall evaluate all Confined Spaces to determine if it is a Permit Required Confined Space.

4.2 Each site shall identify all Permit Required Confined Spaces with a sign. The site's signs shall be standardized with appropriate signage such as, "DANGER – CONFINED SPACE – ENTER BY PERMIT ONLY" or similar language to identify each permit-required confined space. In some cases, it will be an activity within the confined space which creates the hazard that will make the space a Permit Required Confined Space. In this situation the sign must be displayed when the hazardous activity is planned or underway.

4.2.1 There may be situations where it is not feasible to hang a sign on a Permit Required Confined Space (*i.e.,* manhole covers). In these cases, the site shall ensure that all affected personnel are informed.

5.0 Employee Protection

5.1 This standard must be followed at all sites with Permit Required Confined Spaces in which individuals will enter.

5.2 If individuals are prohibited from entering Permit Required Confined Spaces, the site shall take measures to prevent its employees from entering, including the following:

5.2.1 Evaluate the workplace to determine if any spaces are permit-required confined spaces;

5.2.2 Identify the spaces according to section 4.0 of this standard;

5.2.3 If conditions change in a non-permit confined space, space must be re-evaluated and reclassified as a Permit Required Confined Space; and

5.2.4 If contractors enter Permit Required Confined Spaces, section 9.0 must be followed.

6.0 Reclassification of a Permit Required Confined Space When the only known hazards are atmospheric (Scenario 1)

6.1 FMC sites can choose to reclassify a Permit Required Confined Space to a non-Permit Required Confined Space by 2 methods.[1]

6.2 The first method allows reclassification to a non-Permit Required Confined Space if the only hazard in the confined space is an atmospheric hazard (i.e., oxygen concentrations are less than 19.5% or greater than 23.5%, flammable vapors, gases or mist present in quantities that cause the atmosphere to exceed 10% of the Lower Flammable Limit (LFL), or the presence of toxic materials are in the atmosphere above the limits indicated in 3.12.4 above)

[1] The first method is set forth in section 6.0 and the second is in section 7.0.

and the atmospheric hazard can be controlled by continuous forced air ventilation alone.

6.3 If continuous forced air only is used to eliminate the atmospheric hazards in the confined space in accordance with the requirements indicated below, then the site does not need to comply with sections: 10.0, 11.0, 13.0, 14.0, and 15.0. To use this reclassification method, FMC site management must demonstrate the following:

6.3.1 The only hazard posed by the otherwise Permit Required Confined Space is an actual or potential hazardous atmosphere.

6.3.2 Continuous forced air ventilation alone is sufficient to maintain the otherwise Permit Required Confined Space safe for entry.

6.3.3 Monitoring and inspection data is available that supports that the only hazard in the space is an actual or potential hazardous atmosphere.

6.3.4 If an initial entry into the Permit Required Confined Space is necessary to determine there are no non-atmospheric hazards, then the entry shall be done following all of the requirements for a Permit Required Confined Space entry, sections 10.0 through 18.0 of this standard.

6.3.5 Data required to support paragraphs 6.3.1, 6.3.2, and 6.3.3 above is documented and made available to each employee who enters the space.

6.3.6 Any condition making it unsafe to remove an entrance cover shall be eliminated before the cover is removed.

6.3.7 When an entrance cover is removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent people from falling through the opening and that will protect each employee working in the space from foreign objects entering the space.

6.3.8 Before the first employee enters the space, the internal atmosphere shall be tested, with a calibrated direct-reading instrument, for oxygen content, flammable gases, vapors and mists and for potentially toxic air contaminants.

6.3.9 An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere.

6.3.10 Forced air ventilation shall be directed to the area where employees will be present within the space and shall continue until all employees have left the space.

6.3.11 The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

6.3.12 The atmosphere within the space shall be periodically tested to ensure that the forced air ventilation is preventing the accumulation of a hazardous atmosphere. Periodic testing data shall be available to employees who enter the space. Prior to the initial entry, site management shall determine the frequency of periodic monitoring for the specified confined space.

6.3.13 If a hazardous atmosphere is detected through periodic testing:

- Employees shall leave the space immediately;

- The space shall be evaluated to determine how the hazardous atmosphere developed; and

- Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry take place.

6.3.14 FMC site management shall verify that a space is safe for entry through pre-testing and shall issue a written certification that contains the date, location of the space, and the signature of the person providing the certification. The certification shall be made before the first entry and be made available to each employee entering the space.

7.0 Re-classification of a Permit Required Confined Space to a non-Permit Required Confined Space when all hazards atmospheric and non-atmospheric have been eliminated (Scenario 2)

7.1 If a Permit Required Confined Space contains no actual or potential atmospheric hazards and if all other hazards within the space are eliminated without entry into the space, the Permit Required Confined Space may be reclassified as a non-Permit Required Confined Space for as long as the non-atmospheric hazards remain eliminated.

7.2 If it is necessary to enter the Permit Required Confined Space to eliminate hazards, the entry shall be performed as a Permit Required Confined Space and in compliance with section 10.0 through 18.0 of this standard.

7.3 If forced air ventilation is required to eliminate an atmospheric hazard in the space, then the space cannot be reclassified under this section.[2]

7.4 FMC management shall document the basis for determining that all hazards in the space have been eliminated. The certification shall contain the date, location of the space, and the signature of the person making the determination. The certification shall be made available to each employee entering the space.

7.5 If hazards arise within a Permit Required Confined Space that has been declassified to a non-Permit Required Confined Space, each employee in the space shall exit the space immediately. FMC site management shall then reevaluate the space and determine whether it must be reclassified as a Permit Required Confined Space.

8.0 Reclassification from a non-Permit Required Confined Space to a Permit Required Confined Space (Scenario 3)

8.1 When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, FMC

[2] Note: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazard. This is the key difference between this reclassification scenario and the reclassification scenario in section 6.

site management shall reevaluate the space and, if necessary, reclassify it as a Permit Required Confined Space.

9.0 Contractors

9.1 If contractors will enter permit-required confined spaces, the site shall:

9.1.1 Inform the contractor that the workplace contains Permit Required Confined Spaces and that Permit Required Confined Space entry is allowed only through compliance with a permit space program;

9.1.2 Inform the contractor of all aspects and hazards of the Permit Required Confined Space;

9.1.3 Inform the contractor of any precautions or procedures that are required for the protection of employees in or near the Permit Required Confined Space;

9.1.4 Coordinate entry operations with the contractor, when both FMC personnel and contractor personnel will be working in or near Permit Required Confined Spaces; and

9.1.5 Conduct a debrief meeting with the contractor at the conclusion of the entry operation to discuss any hazards confronted or created in permit spaces during entry operations.

10.0 Written Permit Required Confined Space program

10.1 Each FMC site with a Permit Required Confined Space shall establish a written program.

10.2 The written program shall include the following:

10.2.1 Measures necessary to prevent unauthorized entry into Permit Required Confined Spaces;

10.2.2 Permit Required Confined Space identification, hazard assessment and identification;

10.2.3 Procedures necessary for safe Permit Required Confined Space entry;

10.2.4 Confined Space Entry Equipment;

10.2.5 Permit required Confined Space entry conditions;

10.2.6 Permit system;

10.2.7 Duties of Entrants, Attendants and Supervisors;

10.2.8 Management of Contractors who enter Permit Required Confined Spaces;

10.2.9 Employee Training;

10.2.10 Rescue and emergency service;

10.2.11 Program Evaluation; and

10.2.12 Employee participation.

11.0 Procedures necessary for safe Permit Required Confined Space entry

11.1 Each FMC site shall develop and implement procedures and practices necessary for safe Permit Required Confined Space entry operation to include but not limited to the following:

11.1.1 Specifying acceptable entry conditions;

11.1.2 Providing each authorized entrant with an opportunity to observe monitoring or testing of Permit Required Confined Spaces;

11.1.3 Isolation of the Permit Required Confined Space;

11.1.4 Purging, inerting, flushing or ventilating the permit space as necessary to eliminate or control atmospheric hazards; and

11.1.5 Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards, and

11.1.6 Verifying that conditions in the Permit Required Confined Space are acceptable for entry throughout the duration of an authorized entry.

12.0 Permit Required Confined Space Entry Equipment

12.1 Each FMC site shall provide the following equipment and ensure that it is maintained and used properly by employees for the specific entry:

12.1.1 Testing and monitoring equipment needed to test and monitor Permit Required Confined Spaces;

12.1.2 Ventilation equipment needed to obtain acceptable entry conditions;

12.1.3 Communication equipment necessary for attendants to communicate with entrants and emergency rescue services;

12.1.4 PPE as required

12.1.5 Lighting equipment needed to enable employees to see well enough to work safely and to exit the Permit Required Confined space quickly in an emergency;

12.1.6 Barriers or shields as required by 10.2.3.5 above;

12.1.7 Ladders needed for safe ingress and egress by Authorized Entrants;

12.1.8 Rescue and emergency equipment except when this equipment is provided by outside rescue services; and

12.1.9 Any other equipment necessary for safe entry into and rescue from a Permit Required Confined Space

13.0 Permit Required Confined Space Entry Conditions

13.1 The FMC site program shall establish Permit Required Confined Space conditions as follows:

13.1.1 Test conditions in the permit space to determine acceptable entry conditions exist before entry is authorized to begin, except that, if Isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and entry conditions shall be continuously monitored in area where authorized entrants are working;

13.1.2 Test or monitor the Permit Required Confined Space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations;

13.1.3 When testing for atmospheric hazards, test first for Oxygen, then for combustible gasses and vapors, and then for toxic gasses and vapors;

13.1.4 Reevaluate the Permit Required Confined Space when requested by any Authorized Entrant;

13.1.5 Provide each Authorized Entrant with the results of any testing conducted;

13.1.6 At least one Attendant shall be provided outside the Permit Required Confined Space for the duration of entry operations;

13.1.7 If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the Permit Required Confined Spaces being monitored without distraction from the attendant's other responsibilities;

13.1.8 Designate the persons who are to have active roles (as, for example, Authorized Entrants, Attendants, Entry Supervisors or persons who test or monitor the atmosphere in a Permit Required Confined Space) in entry operations, identify the duties of each such employee, and provide each such employee with the training required;

13.1.9 Develop and implement procedures for summoning rescue and emergency services, for rescuing entrants from Permit Required Confined Spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue;

13.1.10 Develop and implement a system for the preparation, issuance, use and cancellation of Permit Required Confined Space entry permits;

13.1.11 Develop and implement procedures to coordinate entry operations when FMC and one or more group of contract employees are working simultaneously as Authorized Entrants in a Permit Required Confined Space, so that employees of one employer do not endanger the employees of any other employer;

13.1.12 Develop and implement procedures (such as closing off a Permit Required Confined Space and canceling the permit) necessary for concluding the entry after entry operations have been completed.

14.0 Permit system

14.1 Each FMC site shall establish a permit system for entry into Permit Required Confined Spaces.

14.2 Each site shall use the permit in Appendix B or equivalent. If the site uses an equivalent permit, the permit must contain, at least, all sections listed in the permit included in Appendix B.

14.3 Before entry is authorized, the Authorized Entry Supervisor shall document the completion of measures required for entry on the permit and sign it.

14.4 The completed permit shall be made available, at the time of entry, to all Authorized Entrants.

14.5 The duration of the permit shall not exceed the time required to complete the assigned task or job identified on the permit.

14.6 The Authorized Entry Supervisor shall terminate entry and cancel the entry permit when:

14.6.1 The entry operations covered by the permit have been completed; or

14.6.2 A condition that is not allowed by the entry permit arises in or near the permit space.

14.7 The FMC site shall retain each canceled entry permit for at least 1 year to facilitate the review of the Permit Required Confined Space program required by section 20.0.

14.8 The permit shall identify:

14.8.1 The Permit Required confined Space to be entered;

14.8.2 The purpose of the entry;

14.8.3 The date and the authorized duration of the entry permit;

14.8.4 The identity of the Authorized Entrants by name or other designation;

14.8.5 The name(s) of the Attendant(s);

14.8.6 The name of the Authorized Entry Supervisor;

14.8.7 The hazards of the Permit Required Confined Space to be entered;

14.8.8 The measures used to isolate the Permit Required Confined Space and to eliminate or control hazards in the Permit Required Confined Space;

14.8.9 The test results of the initial and periodic atmospheric testing shall be recorded on the permit and offered to each authorized entrant for review;

14.8.10 The rescue and emergency services that can be summoned and the means for summoning those services;

14.8.11 The communication procedure to be used to maintain contact between the Authorized Entrant and the Attendant; and

14.8.12 Required equipment, such as PPE, testing, communication, alarm systems, and rescue equipment to be used during the respective entry.

15.0 Training

15.1 The site shall provide training so that all employees involved in confined space entry develop understanding, knowledge, and skills necessary for safe confined space entry.

15.2 Training shall be provided to each affected employee:

15.2.1 Before the employee is first assigned confined space entry duties;

15.2.2 Before there is a change in assigned duties;

15.2.3 Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;

15.2.4 Whenever FMC site management has reason to believe that there have been deviations from the Permit Required Confined Space entry procedures;

15.2.5 Whenever FMC site management determines that there are inadequacies in the employee's knowledge or use of the confined space entry procedures;

15.3 The FMC site shall certify the training required by this standard has been completed. The certification shall contain each employee's printed name and signature, the printed name and signatures of the trainers, and the dates of training.

16.0 Duties of Authorized Entrants

16.1 The FMC site shall ensure that all authorized entrants:

16.1.1 Know all of the hazards of the specific confined space;

16.1.2 Know the signs and symptoms of exposure to high and low concentrations of oxygen and to potential air contaminants.

16.1.3 Know how to properly use equipment;

16.1.4 Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert authorized entrants of the need to evacuate the space as required; and

16.1.5 Alert the authorized attendant whenever the entrant recognizes any warning signs or symptoms of exposure to high or low oxygen or an atmospheric contaminant or the entrant detects a prohibited condition.

16.1.6 Exit from the permit space as quickly as possible whenever:

16.1.6.1 An order to evacuate is given by the attendant or the entry supervisor;

16.1.6.2 The entrant recognizes any warning sign or symptom of exposure to high or low oxygen or an atmospheric contaminant;

16.1.6.3 The entrant detects a prohibited condition; or

16.1.6.4 An evacuation alarm is activated.

17.0 Duties of Authorized Attendants

17.1 The FMC site shall ensure that each attendant:

17.1.1 Knows the atmospheric hazards the entrant may be encounter during entry, including information on the signs or symptoms and consequences of exposures to low or high oxygen or atmospheric contaminants;

17.1.2 Is aware of possible behavioral effects of exposure to high or low oxygen concentrations and atmospheric contaminants;

17.1.3 Continuously maintains an accurate count of authorized entrants in the permit space and ensures that there are means to identify authorized entrants in the permit space;

17.1.4 Remains outside the permit space during entry operations until relieved by another attendant[3];

17.1.5 Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space;

17.1.6 Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the entrants to evacuate the Permit Required Confined Space immediately under any of the following conditions:

17.1.6.1 If the attendant detects a prohibited condition;

17.1.6.2 if the attendant detects the behavioral effects of exposure high or low oxygen or an atmospheric contaminant;

17.1.6.3 If the attendant detects a situation outside the space that could endanger the entrants; or

17.1.6.4 If the attendant cannot effectively and safely perform all of his assigned duties as an attendant.

17.1.7 Summon rescue and other emergency services as soon as the attendant determines that entrants may need assistance to escape from Permit Required Confined Space;

17.1.8 Take the following actions when unauthorized persons approach or enter a permit space while entry is underway;

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[3] Note: When the permit entry program allows an attendant to enter a confined space for rescue purposes, the attendants may enter the Permit Required Confined Space for rescue if they have been trained and equipped for rescue operations and have been relieved by another qualified attendant.

17.1.9 Warn he unauthorized persons that they must stay away from the permit space;

17.1.10 Advise the unauthorized persons that they must exit immediately if they have entered the permit space;

17.1.11 Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;

17.1.12 Performs non-entry rescues as specified by the FMC site's rescue procedure; and

17.1.13 Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

18.0 Duties of Authorized Entry Supervisors

18.1 Prior to the first entry each Authorized Entry Supervisor ensures the following before signing the permit:

18.1.1 The Authorized Entry Supervisor knows the hazards that may be faced during entry, including information on the signs or symptoms of exposure to high or low oxygen concentrations or atmospheric contaminants;

18.1.2 Verifies by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before signing the permit and allowing entry to begin;

18.1.3 Verifies that rescue services are available and that the means for summoning them are operable;

18.1.4 Terminates the entry and cancels the permit as required;

18.1.5 Ensures that unauthorized individuals do not enter the Permit Required Confined Spaces; and

18.1.6 When an Authorized Entry Supervisor leaves the area he/she ensures that responsibility for a Permit Required Confined Space entry operation is transferred to another Authorized Entry Supervisor. The new Authorized Entry Supervisor ensures that the Permit Required Confined Space entry operation remains consistent with the terms of the entry permit and that acceptable entry conditions are maintained.

19.0 Rescue and Emergency Services

19.1 FMC sites that designates non-FMC rescue and emergency services, shall:

19.1.1 Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazards identified[4];

19.1.2 Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces;

19.1.3 Select a rescue team or service from those evaluated that:

19.1.3.1 Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s); and

19.1.3.2 Is equipped for and proficient in performing the needed rescue services;

19.1.4 Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and

19.1.5 Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

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[4] Note: What will be considered timely will vary according to the specific hazards involved in each entry.

19.2 If FMC employee has been designated to provide Permit Required Confined Space rescue and emergency services, the FMC site shall ensure the following measures are followed:

19.2.1 Provide employees selected to provide rescue services with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees;

19.2.2 Train affected employees to perform assigned rescue duties;

19.2.3 Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR), and at least one available member of the rescue team or service holding a current certification in first aid and CPR; and

19.2.4 Ensure that affected FMC employees practice making permit space rescues at least every 12 months, by simulated rescue operations in which they remove articles of appropriate size and weight from the actual permit spaces or from representative permit spaces.

19.3 To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements:

19.3.1 Each authorized entrant shall use a chest or full body harness, with a retrieval line attached to the center of the entrant's back near shoulder level, above the entrant's head, or at another point, which the employer can establish presents a profile small enough for the successful removal of the entrant. Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of the wristlets is the safest and most effective alternative.

19.3.2 The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet (1.52 m) deep.

19.3.3 If an injured entrant is exposed to a substance for which a Safety Data Sheet (SDS) or other similar written information is required to be kept at the worksite, the SDS or written information shall be made available to the medical facility treating the exposed entrant.

20.0 Program Evaluation

20.1 FMC site management shall review entry operations when they have reason to believe that the measures taken under the site confined space entry program may not protect employees and revise the program to correct deficiencies found.

20.2 FMC site management shall review the Permit Required Confined Space program using canceled permits required to be retained for 1 year by this standard and revise the program as necessary, to ensure that employees are adequately protected from Permit Required Confined Space hazards.

Note: FMC site management may perform a single annual review covering all entries performed during a 12 month period. If no entry is performed during a 12 month period, no review is necessary.

21.0 Employee Participation

21.1 FMC site management shall consult with affected employees on the development and implementation of all aspects of the Permit Required Confined Space program.

21.2 FMC site management shall make available to affected employees all information required to be developed by this standard.

22.0 References

22.1 U.S. Occupational Safety and Health Administration 29 CFR 1910.146.

23.0 Effective Date

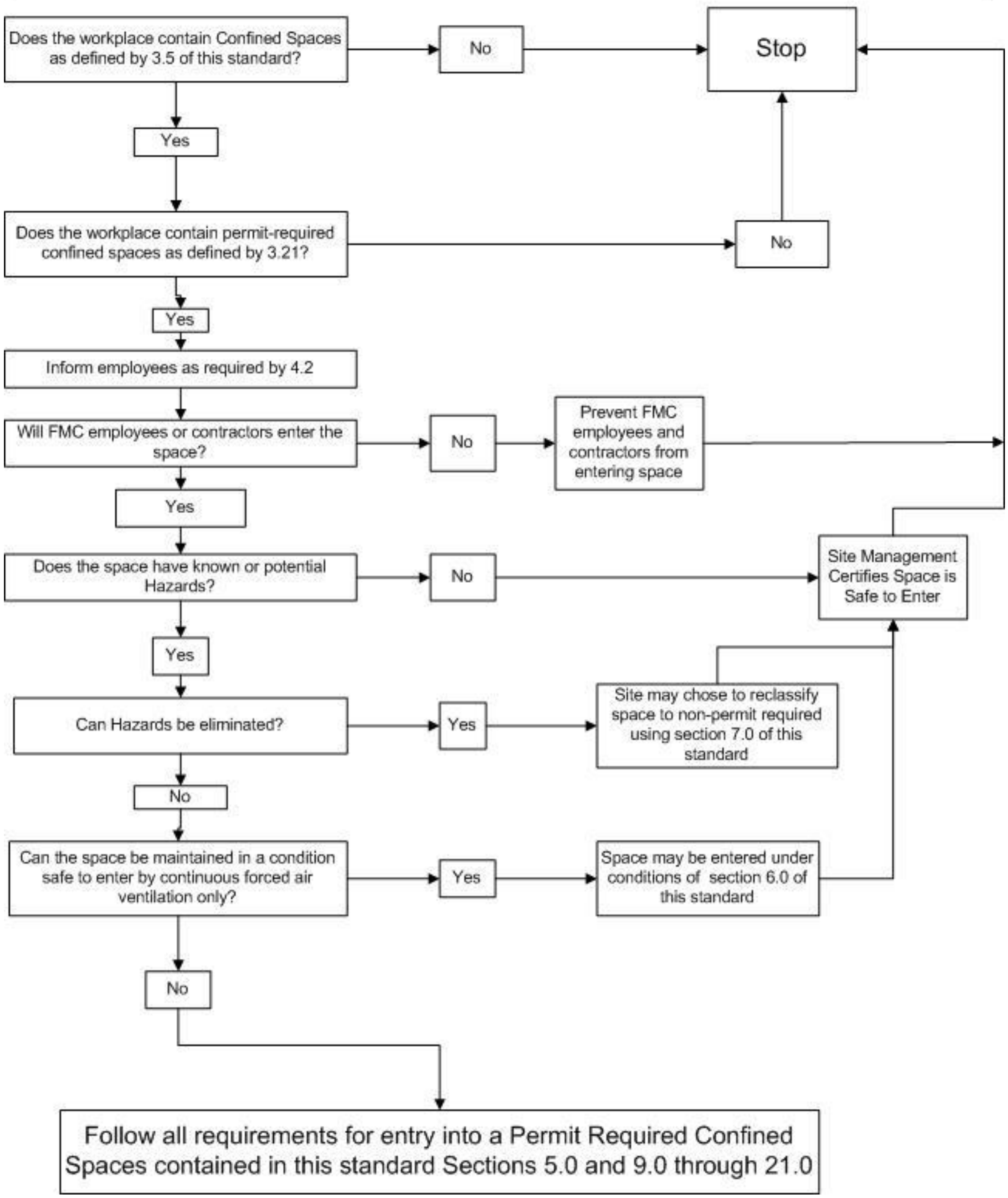
The effective date of this Standard is November 5, 2012, at which time all FMC sites are expected to be in compliance within 3 months of issue except if an extension is specifically granted. This standard will be reviewed and updated within 3 years of the date it is published and every 3 years thereafter.

24.0 Revision History

This Standard was originally issued on November 5, 2012 at Revision 0. It has been revised as follows:

Revision Level	Revision Details	Revision Date (MM/DD/YYYY)	Approval
0	Initial Release	11/5/2012	Rob Haire

Appendix A
Decision Flow Chart for Permit Required Confined Spaces



Appendix B – Confined Space Entry Permit Form

1. **Authorized Entry Supervisor** (print name): ____

2. **Authorized Work Start:** Date: ______ Time: _____ **Authorized Work Stop**: Date: ______Time: ______

3. **Confined Space Id and Location:** ____
(Include Bldg. # & Tank or Vessel ID # if applicable)

4. **Purpose of Entry:** ____
(Scope of the job being performed in the space)

5. **Confined Space Hazards** (indicate specific hazards below) (Initial by Entry Supervisor):

____Oxygen deficiency (less than 19.5%)
____Oxygen enrichment (greater than 23.5%)
____Flammable vapors (greater than 10%)
____Airborne combustible dust
____Mechanical hazards
____Electrical shock
____Engulfment
____Entrapment
____Toxic materials- skin contact
____Toxic material- inhalation
____Other hazards (list below)

____

6. **Hazard Control Checklist- What Is Required/completed** (Initial by Entry Supervisor):

Req'd	Done		Req'd	Done	
____	____	Pre-entry atmospheric testing completed	____	____	Continuous atmospheric monitoring
____	____	Periodic atmospheric monitoring	____	____	Lockout/tagout completed
____	____	All lines disconnected or blanked	____	____	Space has been purged/ flushed/ cleaned
____	____	Continuous ventilation	____	____	Hot work permit
____	____	Entrance barrier	____	____	Appropriate lighting

____ ____Communication with all effected departments complete- operator, supervisor, safety coordinator, environmental etc.
____ ____Other (list)____

____

7. **Personal Protective Equipment Required** (list type, be specific): ______________________________
____
____

8. **Emergency Rescue Service**

Name______________________________________ Phone or Radio #__________________________

Name______________________________________ Phone or Radio #__________________________

Emergency Rescuers Notified (**Initial by Entry Supervisor**):___________

___ About confined space entry time and place
___ About potential hazards they may encounter if rescue is needed
___ They are available to respond
___ Communication method has been verified

9. **Authorized Attendants** print name(s)**:** ____

10. **Entrant Entry & Exit Times**

	In / Out	In / Out	In / Out	In / Out
______________________	___/___	___/___	___/___	___/___
______________________	___/___	___/___	___/___	___/___
______________________	___/___	___/___	___/___	___/___
______________________	___/___	___/___	___/___	___/___

11. Atmospheric Testing completed by (print name) ____

Test For:	Acceptable Levels:	Pre-Entry	Time	Time	Time	Time	Time	Time
%Oxygen:	19.5-23.5%							
Flammable Vapors:	<10%							
CO:	<25ppm							
H_2S:	<10 ppm							
Toxic Substances:	ACGIH TLV							

Testing Equipment:__________________________ Last Equipment Calibration (date)_________________

12. Items Checked By the Entrants (**Initial by Entrant(s)**):__________

___Confined space has been properly prepared
___Adequate rescue equipment and personnel
___Entrant has reviewed and understands permit
___Entrant has locked out equipment
___Adequate PPE

13. Authorized Entry Supervisor Has Completed the Following (Initial by Entry Supervisor):________

___Pre-entry safety meeting with entrants and attendants to ensure everything is complete and everyone understands their role.

14. Authorization by Entry Supervisor(s) for Entrants to Proceed:

____

Print Name Signature Date Time

15. Outside Contractor

I certify that I have observed the conditions listed on this permit and that they are as indicated and I understand that they may change. My company is responsible for additional atmospheric testing of the confined space, and we will contact FMC personnel immediately if testing indicates a hazard. I understand and agree to follow the terms of this permit.

____ ________________________________

(Signature) (Date)

16. Entry Cancellation

____ _____________________________________

(Name) *(Time)*

____ _____________________________________

(Signature) (Date)

Reason for Cancellation

- ☐ *Entry Operation Complete*
- ☐ *Prohibited Condition Arose (Specify):* ____

____
____

NOTE: Return Completed Permits to the Plant Safety Coordinator or other designated site personnel when the job is complete! This permit is only good for the time authorized (time and date on the front of the form).

Method 1669

Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels

July 1996

U.S. Environmental Protection Agency
Office of Water
Engineering and Analysis Division (4303)
401 M Street S.W.
Washington, D.C. 20460

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Disclaimer

This sampling method has been reviewed and approved for publication by the Analytical Methods Staff within the Engineering and Analysis Division of the U.S. Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Further Information

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Introduction

This sampling method was designed to support water quality monitoring programs authorized under the Clean Water Act. Section 304(a) of the Clean Water Act requires EPA to publish water quality criteria that reflect the latest scientific knowledge concerning the physical fate (e.g., concentration and dispersal) of pollutants, the effects of pollutants on ecological and human health, and the effect of pollutants on biological community diversity, productivity, and stability.

Section 303 of the Clean Water Act requires states to set a water quality standard for each body of water within its boundaries. A state water quality standard consists of a designated use or uses of a waterbody or a segment of a waterbody, the water quality criteria that are necessary to protect the designated use or uses, and an antidegradation policy. These water quality standards serve two purposes: (1) they establish the water quality goals for a specific waterbody, and (2) they are the basis for establishing water quality-based treatment controls and strategies beyond the technology-based controls required by Sections 301(b) and 306 of the Clean Water Act.

In defining water quality standards, the state may use narrative criteria, numeric criteria, or both. However, the 1987 amendments to the Clean Water Act required states to adopt numeric criteria for toxic pollutants (designated in Section 307(a) of the Act) based on EPA Section 304(a) criteria or other scientific data, when the discharge or presence of those toxic pollutants could reasonably be expected to interfere with designated uses.

In some cases, these water quality criteria are as much as 280 times lower than those achievable using existing EPA methods and required to support technology-based permits. Therefore, this sampling method, and the analytical methods referenced in Table 1 of this document, were developed by EPA to specifically address state needs for measuring toxic metals at water quality criteria levels, when such measurements are necessary to protect designated uses in state water quality standards. The latest criteria published by EPA are those listed in the National Toxics Rule (57 *FR* 60848) and the Stay of Federal Water Quality Criteria for Metals (60 *FR* 22228). These rules include water quality criteria for 13 metals, and it is these criteria on which this sampling method and the referenced analytical methods are based.

In developing these methods, EPA found that one of the greatest difficulties in measuring pollutants at these levels was precluding sample contamination during collection, transport, and analysis. The degree of difficulty, however, is highly dependent on the metal and site-specific conditions. This method, therefore, is designed to provide the level of protection necessary to preclude contamination in nearly all situations. It is also designed to provide the procedures necessary to produce reliable results at the lowest possible water quality criteria published by EPA. In recognition of the variety of situations to which this method may be applied, and in recognition of continuing technological advances, the method is performance-based. Alternative procedures may be used, so long as those procedures are demonstrated to yield reliable results.

Requests for additional copies of this method should be directed to:

U.S. EPA NCEPI
11029 Kenwood Road
Cincinnati, OH 45242
513/489–8190

Note: This document is intended as guidance only. Use of the terms "must," "may," and "should" are included to mean that EPA believes that these procedures must, may, or should be followed in order to produce the desired results when using this guidance. In addition, the guidance is intended to be performance-based, in that the use of less stringent procedures may be used so long as neither samples nor blanks are contaminated when following those modified procedures. Because the only way to measure the performance of the modified procedures is through the collection and analysis of uncontaminated blank samples in accordance with this guidance and the referenced methods, it is highly recommended that any modifications be thoroughly evaluated and demonstrated to be effective before field samples are collected.

Method 1669

Sampling Ambient Water for Determination of Metals at EPA Water Quality Criteria Levels

1.0 Scope and Application

1.1 This method is for the collection and filtration of ambient water samples for subsequent determination of total and dissolved metals at the levels listed in Table 1. It is designed to support the implementation of water quality monitoring and permitting programs administered under the Clean Water Act.

1.2 This method is applicable to the metals listed below and other metals, metals species, and elements amenable to determination at trace levels.

Analyte	Symbol	Chemical Abstract Services Registry Number (CASRN)
Antimony	(Sb)	7440-36-0
Arsenic	(As)	7440-38-2
Cadmium	(Cd)	7440-43-9
Chromium (III)	Cr^{+3}	16065-83-1
Chromium (VI)	Cr^{+6}	18540-29-9
Copper	(Cu)	7440-50-8
Lead	(Pb)	7439-92-1
Mercury	(Hg)	7439-97-6
Nickel	(Ni)	7440-02-0
Selenium	(Se)	7782-49-2
Silver	(Ag)	7440-22-4
Thallium	(Tl)	7440-28-0
Zinc	(Zn)	7440-66-6

1.3 This method is accompanied by the 1600 series methods listed in Table 1. These methods include the sample handling, analysis, and quality control procedures necessary for reliable determination of trace metals in aqueous samples.

1.4 This method is not intended for determination of metals at concentrations normally found in treated and untreated discharges from industrial facilities. Existing regulations (40 *CFR* Parts 400-500) typically limit concentrations in industrial discharges to the mid to high part-per-billion (ppb) range, whereas ambient metals concentrations are normally in the low part-per-trillion (ppt) to low ppb range. This guidance is therefore directed at the collection of samples to be measured at or near the levels listed in Table 1. Actual concentration ranges to which this guidance is applicable will be dependent on the sample matrix, dilution levels, and other laboratory operating conditions.

1.5 The ease of contaminating ambient water samples with the metal(s) of interest and interfering substances cannot be overemphasized. This method includes sampling techniques that should maximize the ability of the sampling team to collect samples reliably and eliminate sample contamination. These techniques are given in Section 8.0 and are based on findings of researchers performing trace metals analyses (References 1-9).

1.6 Clean and Ultraclean—The terms "clean" and "ultraclean" have been used in other Agency guidance to describe the techniques needed to reduce or eliminate contamination in trace metals determinations. These terms are not used in this sampling method due to a lack of exact definitions. However, the information provided in this method is consistent with summary guidance on clean and ultraclean techniques (Reference 10).

1.7 This sampling method follows the EPA Environmental Methods Management Council's "Format for Method Documentation" (Reference 11).

1.8 Method 1669 is "performance-based"; i.e., an alternate sampling procedure or technique may be used, so long as neither samples nor blanks are contaminated when following the alternate procedures. Because the only way to measure the performance of the alternate procedures is through the collection and analysis of uncontaminated blank samples in accordance with this guidance and the methods referenced in Table 1, it is highly recommended that any modifications be thoroughly evaluated and demonstrated to be effective before field samples are collected. Section 9.2 provides additional details on the tests and documentation required to support equivalent performance.

1.9 For dissolved metal determinations, samples must be filtered through a 0.45 µm capsule filter at the field site. The filtering procedures are described in this method. The filtered samples may be preserved in the field or transported to the laboratory for preservation. Procedures for field preservation are detailed in this sampling method; procedures for laboratory preservation are provided in the methods referenced in Table 1. Preservation requirements are summarized in Table 2.

1.10 The procedures in this method are for use only by personnel thoroughly trained in the collection of samples for determination of metals at ambient water quality control levels.

2.0 Summary of Method

2.1 Before samples are collected, all sampling equipment and sample containers are cleaned in a laboratory or cleaning facility using detergent, mineral acids, and reagent water as described in the methods referenced in Table 1. The laboratory or cleaning facility is responsible for generating an acceptable equipment blank to demonstrate that the sampling equipment and containers are free from trace metals contamination before they are shipped to the field sampling team. An acceptable blank is one that is free from contamination below the minimum level (ML) specified in the referenced analytical method (Section 9.3).

2.2 After cleaning, sample containers are filled with weak acid solution, individually double-bagged, and shipped to the sampling site. All sampling equipment is also bagged for storage or shipment.

NOTE: *EPA has found that, in some cases, it may be possible to empty the weak acid solution from the bottle immediately prior to transport to the field site. In this case, the bottle should be refilled with reagent water (Section 7.1).*

2.3 The laboratory or cleaning facility must prepare a large carboy or other appropriate clean container filled with reagent water (Section 7.1) for use with collection of field blanks during sampling activities. The reagent-water-filled container should be shipped to the field site and handled as all other sample containers and sampling equipment. At least one field blank should be processed per site, or one per every ten samples, whichever is more frequent (Section 9.4). If samples are to be collected for determination of trivalent chromium, the sampling team processes additional QC aliquots are processed as described in Section 9.6.

2.4 Upon arrival at the sampling site, one member of the two-person sampling team is designated as "dirty hands"; the second member is designated as "clean hands." All operations involving contact with the sample bottle and transfer of the sample from the sample collection device to the sample bottle are handled by the individual designated as "clean hands." "Dirty hands" is responsible for preparation of the sampler (except the sample container itself), operation of any machinery, and for all other activities that do not involve direct contact with the sample.

2.5 All sampling equipment and sample containers used for metals determinations at or near the levels listed in Table 1 must be nonmetallic and free from any material that may contain metals.

2.6 Sampling personnel are required to wear clean, nontalc gloves at all times when handling sampling equipment and sample containers.

2.7 In addition to processing field blanks at each site, a field duplicate must be collected at each sampling site, or one field duplicate per every 10 samples, whichever is more frequent (Section 9.5). Section 9.0 gives a complete description of quality control requirements.

2.8 Sampling

2.8.1 Whenever possible, samples are collected facing upstream and upwind to minimize introduction of contamination.

2.8.2 Samples may be collected while working from a boat or while on land.

2.8.3 Surface samples are collected using a grab sampling technique. The principle of the grab technique is to fill a sample bottle by rapid immersion in water and capping to minimize exposure to airborne particulate matter.

2.8.4 Subsurface samples are collected by suction of the sample into an immersed sample bottle or by pumping the sample to the surface.

2.9 Samples for dissolved metals are filtered through a 0.45 µm capsule filter at the field site. After filtering, the samples are double-bagged and iced immediately. Sample containers are shipped to the analytical laboratory. The sampling equipment is shipped to the laboratory or cleaning facility for recleaning.

2.10 Acid preservation of samples is performed in the field or in the laboratory. Field preservation is necessary for determinations of trivalent chromium. It has also been shown that field preservation can increase sample holding times for hexavalent chromium to 30 days; therefore it is recommended that preservation of samples for hexavalent chromium be performed in the field. For other metals, however, the sampling team may prefer to utilize laboratory preservation of samples to expedite field operations and to minimize the potential for sample contamination.

2.11 Sampling activities must be documented through paper or computerized sample tracking systems.

3.0 Definitions

3.1 Apparatus—Throughout this method, the sample containers, sampling devices, instrumentation, and all other materials and devices used in sample collection, sample processing, and sample analysis activities will be referred to collectively as the Apparatus.

3.2 Definitions of other terms are given in the Glossary (Section 15.0) at the end of this method.

4.0 Contamination and Interferences

4.1 Contamination Problems in Trace Metals Analysis

4.1.1 Preventing ambient water samples from becoming contaminated during the sampling and analytical process is the greatest challenge faced in trace metals determinations. In recent years, it has been shown that much of the historical trace metals data collected in ambient water are erroneously high because the concentrations reflect contamination from sampling and analysis rather than ambient levels (Reference 12). Therefore, it is imperative that extreme care be taken to avoid contamination when collecting and analyzing ambient water samples for trace metals.

4.1.2 There are numerous routes by which samples may become contaminated. Potential sources of trace metals contamination during sampling include metallic or metal-containing sampling equipment, containers, labware (e.g. talc gloves that contain high levels of zinc), reagents, and deionized water; improperly cleaned and stored equipment, labware, and reagents; and atmospheric inputs such as dirt and dust from automobile exhaust, cigarette smoke, nearby roads, bridges, wires, and poles. Even human contact can be a source of trace metals contamination. For example, it has been demonstrated that dental work (e.g., mercury amalgam fillings) in the mouths of laboratory personnel can contaminate samples that are directly exposed to exhalation (Reference 3).

4.2 Contamination Control

4.2.1 Philosophy—The philosophy behind contamination control is to ensure that any object or substance that contacts the sample is nonmetallic and free from any material that may contain metals of concern.

4.2.1.1 The integrity of the results produced cannot be compromised by contamination of samples. Requirements and suggestions for controlling sample contamination are given in this sampling method and in the analytical methods referenced in Table 1.

4.2.1.2 Substances in a sample or in the surrounding environment cannot be allowed to contaminate the Apparatus used to collect samples for trace metals measurements. Requirements and suggestions for protecting the

Apparatus are given in this sampling method and in the methods referenced in Table 1.

4.2.1.3 While contamination control is essential, personnel health and safety remain the highest priority. Requirements and suggestions for personnel safety are given in Section 5 of this sampling method and in the methods referenced in Table 1.

4.2.2 Avoiding contamination—The best way to control contamination is to completely avoid exposure of the sample and Apparatus to contamination in the first place. Avoiding exposure means performing operations in an area known to be free from contamination. Two of the most important factors in avoiding/reducing sample contamination are (1) an awareness of potential sources of contamination and (2) strict attention to work being performed. Therefore, it is imperative that the procedures described in this method be carried out by well trained, experienced personnel. Documentation of training should be kept on file and readily available for review.

4.2.2.1 Minimize exposure—The Apparatus that will contact samples or blanks should only be opened or exposed in a clean room, clean bench, glove box, or clean plastic bag, so that exposure to atmospheric inputs is minimized. When not being used, the Apparatus should be covered with clean plastic wrap, stored in the clean bench or in a plastic box or glove box, or bagged in clean, colorless zip-type bags. Minimizing the time between cleaning and use will also reduce contamination.

4.2.2.2 Wear gloves—Sampling personnel must wear clean, nontalc gloves (Section 6.7) during all operations involving handling of the Apparatus, samples, and blanks. Only clean gloves may touch the Apparatus. If another object or substance is touched, the glove(s) must be changed before again handling the Apparatus. If it is even suspected that gloves have become contaminated, work must be halted, the contaminated gloves removed, and a new pair of clean gloves put on. Wearing multiple layers of clean gloves will allow the old pair to be quickly stripped with minimal disruption to the work activity.

4.2.2.3 Use metal-free Apparatus—All Apparatus used for metals determinations at the levels listed in Table 1 must be nonmetallic and free of material that may contain metals. When it is not possible to obtain equipment that is completely free of the metal(s) of interest, the sample should not come into direct contact with the equipment.

4.2.2.3.1 Construction materials—Only the following materials should come in contact with samples: fluoropolymer (FEP, PTFE), conventional or linear polyethylene, polycarbonate, polysulfone, polypropylene, or ultrapure quartz. PTFE is less desirable than FEP because the sintered material in PTFE may contain contaminants and is susceptible to serious memory effects (Reference 6). Fluoropolymer or glass containers should be used for samples that will be analyzed for mercury because mercury vapors can diffuse in or out of other materials, resulting either in contamination or low-biased results (Reference 3). Metal must not be used under any circumstance. Regardless of construction, all materials that will directly or indirectly contact the sample must be cleaned using the procedures described in the referenced analytical methods (see Table 1) and must be known to be clean and metal-free before proceeding.

4.2.2.3.2 The following materials have been found to contain trace metals and must not be used to hold liquids that come in contact with the sample or must not contact the sample, unless these materials have been shown to be free of the metals of interest at the desired level: Pyrex, Kimax, methacrylate, polyvinylchloride, nylon, and Vycor (Reference 6). In addition, highly colored plastics, paper cap liners, pigments used to mark increments on plastics, and rubber all contain trace levels of metals and must be avoided (Reference 13).

4.2.2.3.3 Serialization—Serial numbers should be indelibly marked or etched on each piece of Apparatus so that contamination can be traced, and logbooks should be maintained to track the sample from the container through the sampling process to shipment to the laboratory. Chain-of-custody procedures may also be used if warranted so that contamination can be traced to particular handling procedures or lab personnel.

4.2.2.3.4 The Apparatus should be clean when the sampling team receives it. If there are any indications that the Apparatus is not clean (e.g., a ripped storage bag), an assessment of the likelihood of contamination must be made. Sampling must not proceed if it is possible that the Apparatus is contaminated. If the Apparatus is contaminated, it must be returned to the laboratory or cleaning facility for proper cleaning before any sampling activity resumes.

4.2.2.3.5 Details for recleaning the Apparatus between collection of individual samples are provided in Section 10.0.

4.2.2.4 Avoid sources of contamination—Avoid contamination by being aware of potential sources and routes of contamination.

4.2.2.4.1 Contamination by carryover—Contamination may occur when a sample containing low concentrations of metals is processed immediately after a sample containing relatively high concentrations of these metals. At sites where more than one sample will be collected, the sample known or expected to contain the lowest concentration of metals should be collected first with the sample containing the highest levels collected last (Section 8.1.4). This will help minimize carryover of metals from high- concentration samples to low- concentration samples. If the sampling team does not have prior knowledge of the waterbody, or when necessary, the sample collection system should be rinsed with dilute acid and reagent water between samples and followed by collection of a field blank (Section 10.3).

4.2.2.4.2 Contamination by samples—Significant contamination of the Apparatus may result when untreated effluents, in-process waters, landfill leachates, and other samples containing mid- to high-level concentrations of inorganic substances are processed. As stated in Section 1.0, this sampling method is not intended for application to these samples, and samples containing high concentrations of metals must not be collected, processed, or shipped at the same time as samples being collected for trace metals determinations.

4.2.2.4.3 Contamination by indirect contact—Apparatus that may not directly contact samples may still be a source of contamination. For example, clean tubing placed in a dirty plastic bag may pick up contamination from the bag and subsequently transfer the contamination to the sample. Therefore, it is imperative that every piece of the Apparatus that is directly or indirectly used in the collection of ambient water samples be cleaned as specified in the analytical method(s) referenced in Table 1.

4.2.2.4.4 Contamination by airborne particulate matter—Less obvious substances capable of contaminating samples include airborne particles. Samples may be contaminated by airborne dust, dirt, particulate matter, or vapors from automobile exhaust; cigarette smoke; nearby corroded or rusted bridges, pipes, poles, or wires; nearby roads; and even human breath (Section 4.1.2). Whenever possible, the sampling activity should occur as far as possible from sources of airborne contamination (Section 8.1.3). Areas where nearby soil is bare and subject to wind erosion should be avoided.

4.3 Interferences—Interferences resulting from samples will vary considerably from source to source, depending on the diversity of the site being sampled. If a sample is suspected of containing substances that may interfere in the determination of trace metals, sufficient sample should be collected to allow the laboratory to identify and overcome interference problems.

5.0 Safety

5.1 The toxicity or carcinogenicity of the chemicals used in this method has not been precisely determined; however, these chemicals should be treated as a potential health hazard. Exposure should be reduced to the lowest possible level. Sampling teams are responsible for maintaining a current awareness file of OSHA regulations for the safe handling of the chemicals specified in this method. A reference file of Material Safety Data Sheets should also be made available to all personnel involved in sampling. It is also suggested that the organization responsible perform personal hygiene monitoring of each sampling team member who uses this method and that the results of this monitoring be made available to the member.

5.2 Operating in and around waterbodies carries the inherent risk of drowning. Life jackets must be worn when operating from a boat, when sampling in more than a few feet of water, or when sampling in swift currents.

5.3 Collecting samples in cold weather, especially around cold water bodies, carries the risk of hypothermia, and collecting samples in extremely hot and humid weather carries the risk of dehydration and heat stroke. Sampling team members should wear adequate clothing for protection in cold weather and should carry an adequate supply of water or other liquids for protection against dehydration in hot weather.

6.0 Apparatus and Materials

NOTE: *Brand names, suppliers, and part numbers are for illustration only and no endorsement is implied. Equivalent performance may be achieved using apparatus and materials other than those specified here. Meeting the performance requirements of this method is the responsibility of the sampling team and laboratory.*

6.1 All sampling equipment and sample containers must be precleaned in a laboratory or cleaning facility, as described in the methods referenced in Table 1, before they are shipped to the field site. Performance criteria for equipment cleaning is described in the referenced methods. To minimize difficulties in sampling, the equipment should be packaged and arranged to minimize field preparation.

6.2 Materials such as gloves (Section 6.7), storage bags (Section 6.8), and plastic wrap (Section 6.9), may be used new without additional cleaning unless the results of the equipment blank pinpoint any of these materials as a source of contamination. In this case, either a different supplier must be obtained or the materials must be cleaned.

6.3 Sample Bottles—Fluoropolymer (FEP, PTFE), conventional or linear polyethylene, polycarbonate, or polypropylene; 500 mL or 1 L with lids. If mercury is a target analyte, fluoropolymer or glass bottles should be used. Refer to the methods referenced in Table 1 for bottle cleaning procedures.

6.3.1 Cleaned sample bottles should be filled with 0.1% HCl (v/v). In some cases, it may be possible to empty the weak acid solution from the sample bottle immediately prior to transport to the field site. In this case, the bottle should be refilled with reagent water (Section 7.1).

6.3.2 Whenever possible, sampling devices should be cleaned and prepared for field use in a class 100 clean room. Preparation of the devices in the field should be done within the glove bag (Section 6.6). Regardless of design, sampling devices must be constructed of nonmetallic material (Section 4.2.2.3.1) and free from material that contains metals. Fluoropolymer or other material shown not to adsorb or contribute mercury must be used if mercury is a target analyte; otherwise, polyethylene, polycarbonate, or polypropylene are acceptable. Commercially available sampling devices may be used provided that any metallic or metal-containing parts are replaced with parts constructed of nonmetallic material.

6.4 Surface Sampling Devices—Surface samples are collected using a grab sampling technique. Samples may be collected manually by direct submersion of the bottle into the water or by using a grab sampling device. Examples of grab samplers are shown in Figures 1 and 2 and may be used at sites where depth profiling is neither practical nor necessary.

6.4.1 The grab sampler in Figure 1 consists of a heavy fluoropolymer collar fastened to the end of a 2-m-long polyethylene pole, which serves to remove the sampling personnel from the immediate vicinity of the sampling point. The collar holds the sample bottle. A fluoropolymer closing mechanism, threaded onto the bottle, enables the sampler to open and close the bottle under water, thereby avoiding surface microlayer contamination (Reference 14). Polyethylene, polycarbonate, and polypropylene are also acceptable construction materials unless mercury is a target analyte. Assembly of the cleaned sampling device is as follows (refer to Figure 1):

6.4.1.1 Thread the pull cord (with the closing mechanism attached) through the guides and secure the pull ring with a simple knot. Screw a sample bottle onto the closing device and insert the bottle into the collar. Cock the closing plate so that the plate is pushed away from the operator.

6.4.1.2 The cleaned and assembled sampling device should be stored in a double layer of large, clean zip-type polyethylene bags or wrapped in two layers of clean polyethylene wrap if it will not be used immediately.

6.4.2 An alternate grab sampler design is shown in Figure 2. This grab sampler is used for discrete water samples and is constructed so that a capped clean bottle can be submerged, the cap removed, sample collected, and bottle recapped at a selected depth. This device eliminates sample contact with conventional samplers (e.g., Niskin bottles), thereby reducing the risk of extraneous contamination. Because a fresh bottle is used for each sample, carryover from previous samples is eliminated (Reference 15).

6.5 Subsurface Sampling Devices—Subsurface sample collection may be appropriate in lakes and sluggish deep river environments or where depth profiling is determined to be necessary. Subsurface samples are collected by pumping the sample into a sample bottle. Examples of subsurface collection systems include the jar system device shown in Figure 3 and described in Section 6.5.1 or the continuous-flow apparatus shown in Figure 4 and described in Section 6.5.2.

6.5.1 Jar sampler (Reference 14)—The jar sampler (Figure 3) is comprised of a heavy fluoropolymer 1-L jar with a fluoropolymer lid equipped with two 1/4 in. fluoropolymer fittings. Sample enters the jar through a short length of fluoropolymer tubing inserted into one fitting. Sample is pulled into the jar by pumping on fluoropolymer tubing attached to the other fitting. A thick fluoropolymer plate supports the jar and provides attachment points for a fluoropolymer safety line and fluoropolymer torpedo counterweight.

6.5.1.1 Advantages of the jar sampler for depth sampling are (1) all wetted surfaces are fluoropolymer and can be rigorously cleaned; (2) the sample is collected into a sample jar from which the sample is readily recovered, and the jar can be easily recleaned; (3) the suction device (a peristaltic or rotary vacuum pump, Section 6.15) is located in the boat, isolated from the sampling jar; (4) the sampling jar can be continuously flushed with sample, at sampling depth, to equilibrate the system; and (5) the sample does not travel through long lengths of tubing that are more difficult to clean and keep clean (Reference 14). In addition, the device is designed to eliminate atmospheric contact with the sample during collection.

6.5.1.2 To assemble the cleaned jar sampler, screw the torpedo weight onto the machined bolt attached to the support plate of the jar sampler. Attach a section of the 1/4 in. o.d. tubing to the jar by inserting the tubing into the fitting on the lid and pushing down into the jar until approximately 8 cm from the bottom. Tighten the fitting nut securely. Attach the solid safety line to the jar sampler using a bowline knot to the loop affixed to the support plate.

6.5.1.3 For the tubing connecting the pump to the sampler, tubing lengths of up to 12 m have been used successfully (Reference 14).

6.5.2 Continuous-flow sampler (References 16-17)—This sampling system, shown in Figure 4, consists of a peristaltic or submersible pump and one or more lengths of precleaned fluoropolymer or styrene/ethylene/butylene/ silicone (SEBS) tubing. A filter is added to the sampling train when sampling for dissolved metals.

6.5.2.1 Advantages of this sampling system include (1) all wetted surfaces are fluoropolymer or SEBS and can be readily cleaned; (2) the suction device is located in the boat, isolated from the sample bottle; (3) the sample does not travel through long lengths of tubing that are difficult to clean and keep clean; and (4) in-line filtration is possible, minimizing field handling requirements for dissolved metals samples.

6.5.2.2 The sampling team assembles the system in the field as described in Section 8.2.8. System components include an optional polyethylene pole to remove sampling personnel from the immediate vicinity of the sampling point and the pump, tubing, filter, and filter holder listed in Sections 6.14 and 6.15.

6.6 Field-Portable Glove Bag—I2R, Model R-37-37H (nontalc), or equivalent. Alternately, a portable glove box may be constructed with a nonmetallic (PVC pipe or other suitable material) frame and a frame cover made of an inexpensive, disposable, nonmetallic material (e.g., a thin-walled polyethylene bag) (Reference 7).

6.7 Gloves—Clean, nontalc polyethylene, latex, vinyl, or PVC; various lengths. Shoulder-length gloves are needed if samples are to be collected by direct submersion of the sample bottle into the water or when sampling for mercury.

6.7.1 Gloves, shoulder-length polyethylene—Associated Bag Co., Milwaukee, WI, 66-3-301, or equivalent.

6.7.2 Gloves, PVC—Fisher Scientific Part No. 11-394-100B, or equivalent.

6.8 Storage Bags—Clean, zip-type, nonvented, colorless polyethylene (various sizes).

6.9 Plastic Wrap—Clean, colorless polyethylene.

6.10 Cooler—Clean, nonmetallic, with white interior for shipping samples.

6.11 Ice or Chemical Refrigerant Packs—To keep samples chilled in the cooler during shipment.

6.12 Wind Suit—Pamida, or equivalent.

NOTE: *This equipment is necessary only for collection of metals, such as mercury, that are known to have elevated atmospheric concentrations.*

6.12.1 An unlined, long-sleeved wind suit consisting of pants and jacket and constructed of nylon or other synthetic fiber is worn when sampling for mercury to prevent mercury adsorbed onto cotton or other clothing materials from contaminating samples.

6.12.2 Washing and drying—The wind suit is washed by itself or with other wind suits only in a home or commercial washing machine and dried in a clothes dryer. The clothes dryer must be thoroughly vacuumed, including the lint filter, to remove all traces of lint before drying. After drying, the wind suit is folded and stored in a clean polyethylene bag for shipment to the sample site.

6.13 Boat

6.13.1 For most situations (e.g., most metals under most conditions), the use of an existing, available boat is acceptable. A flat-bottom, Boston Whaler-type boat is preferred because sampling materials can be stored with reduced chance of tipping.

6.13.1.1 Immediately before use, the boat should be washed with water from the sampling site away from any sampling points to remove any dust or dirt accumulation.

6.13.1.2 Samples should be collected upstream of boat movement.

6.13.2 For mercury, and for situations in which the presence of contaminants cannot otherwise be controlled below detectable levels, the following equipment and precautions may be necessary:

6.13.2.1 A metal-free (e.g., fiberglass) boat, along with wooden or fiberglass oars. Gasoline- or diesel-fueled boat motors should be avoided when possible because the exhaust can be a source of contamination. If the body of water is large enough to require use of a boat motor, the engine should be shut off at a distance far enough from the sampling point to avoid contamination, and the sampling team should manually propel the boat to the sampling point. Samples should be collected upstream of boat movement.

6.13.2.2 Before first use, the boat should be cleaned and stored in an area that minimizes exposure to dust and atmospheric particles. For example, cleaned boats should not be stored in an area that would allow exposure to automobile exhaust or industrial pollution.

6.13.2.3 The boat should be frequently visually inspected for possible contamination.

6.13.2.4 After sampling, the boat should be returned to the laboratory or cleaning facility, cleaned as necessary, and stored away from any sources of contamination until next use.

6.14 Filtration Apparatus—Required when collecting samples for dissolved metals determinations.

6.14.1 Filter—0.45 µm, 15 mm diameter or larger, tortuous-path capsule filters (Reference 18), Gelman Supor 12175, or equivalent.

6.14.2 Filter holder—For mounting filter to the gunwale of the boat. Rod or pipe made from plastic material and mounted with plastic clamps.

NOTE: *A filter holder may not be required if one or a few samples are to be collected. For these cases, it may only be necessary to attach the filter to the outlet of the tubing connected to the pump.*

6.15 Pump and Pump Apparatus—Required for use with the jar sampling system (Section 6.5.1) or the continuous-flow system (Section 6.5.2). Peristaltic pump; 115 V a.c., 12 V d.c., internal battery, variable-speed, single-head, Cole-Parmer, portable, "Masterflex L/S," Catalog No. H-07570-10 drive with Quick Load pump head, Catalog No. H-07021-24, or equivalent.

NOTE: *Equivalent pumps may include rotary vacuum, submersible, or other pumps free from metals and suitable to meet the site-specific depth sampling needs.*

6.15.1 Cleaning—Peristaltic pump modules do not require cleaning. However, nearly all peristaltic pumps contain a metal head and metal controls. Touching the head or controls necessitates changing of gloves before touching the Apparatus. If a submersible pump is used, a large volume of sample should be pumped to clean the stainless steel shaft (hidden behind the impeller) that comes in contact with the sample. Pumps with metal impellers should not be used.

6.15.2 Tubing—For use with peristaltic pump. SEBS resin, approximately 3/8 in. i.d. by approximately 3 ft, Cole-Parmer size 18, Cat. No. G-06464-18, or approximately 1/4 in. i.d., Cole-Parmer size 17, Catalog No. G-06464-17, or equivalent. Tubing is cleaned by soaking in 5-10% HCl solution for 8-24 hours, rinsing with reagent water in a clean bench in a clean room, and drying in the clean bench by purging with mercury-free air or nitrogen. After drying, the tubing is double-bagged in clear polyethylene bags, serialized with a unique number, and stored until use.

6.15.3 Tubing—For connection to peristaltic pump tubing. Fluoropolymer, 3/8 or 1/4 in. o.d., in lengths as required to reach the point of sampling. If sampling will be at some depth from the end of a boom extended from a boat, sufficient tubing to extend to the end of the boom and to the depth will be required. Cleaning of the fluoropolymer can be the same as cleaning the tubing for the rotary vacuum pump (Section 6.15.1.2). If necessary, more aggressive cleaning (e.g., concentrated nitric acid) may be used.

6.15.4 Batteries to operate submersible pump—12 V, 2.6 amp, gel cell, YUASA NP2.6-12, or equivalent. A 2 amp fuse connected at the positive battery terminal is strongly recommended to prevent short circuits from overheating the battery. A 12 V, lead-acid automobile or marine battery may be more suitable for extensive pumping.

6.15.5 Tubing connectors—Appropriately sized PVC, clear polyethylene, or fluoropolymer "barbed" straight connectors cleaned as the tubing above. Used to connect multiple lengths of tubing.

6.16 Carboy—For collection and storage of dilute waste acids used to store bottles.

6.17 Apparatus—For field preservation of aliquots for trivalent chromium determinations.

6.17.1 Fluoropolymer forceps—1 L fluoropolymer jar, and 30 mL fluoropolymer vials with screw-caps (one vial per sample and blank). It is recommended that 1 mL of ultrapure nitric acid (Section 7.3) be added to each vial prior to transport to the field to simplify field handling activities (See Section 8.4.4.6).

6.17.2 Filters—0.4 µm, 47 mm polycarbonate Nuclepore (or equivalent). Filters are cleaned as follows. Fill a 1 L fluoropolymer jar approximately two-thirds full with 1 N nitric acid. Using fluoropolymer forceps, place individual filters in the fluoropolymer jar. Allow the filters to soak for 48 hours. Discard the acid, and rinse five times with reagent water. Fill the jar with reagent water, and soak the filters for 24 hours. Remove the filters when ready for use, and using fluoropolymer forceps, place them on the filter apparatus (Section 6.17.3).

6.17.3 Vacuum filtration apparatus—Millipore 47 mm size, or equivalent, vacuum pump and power source (and extension cords, if necessary) to operate the pump.

6.17.4 Eppendorf auto pipet and colorless pipet tips (100-1000 µL)

6.17.5 Wrist-action shaker—Burrel or equivalent.

6.17.6 Fluoropolymer wash bottles—One filled with reagent water (Section 7.1) and one filled with high- purity 10% HCl (Section 7.4.4), for use in rinsing forceps and pipet tips.

7.0 Reagents and Standards

7.1 Reagent Water—Water in which the analytes of interest and potentially interfering substances are not detected at the Method Detection Limit (MDL) of the analytical method used for analysis of samples. Prepared by distillation, deionization, reverse osmosis, anodic/cathodic stripping voltammetry, or other techniques that remove the metal(s) and potential interferent(s). A large carboy or other appropriate container filled with reagent water must be available for the collection of field blanks.

7.2 Nitric Acid—Dilute, trace-metal grade, shipped with sampling kit for cleaning equipment between samples.

7.3 Sodium Hydroxide—Concentrated, 50% solution for use when field-preserving samples for hexavalent chromium determinations (Section 8.4.5).

7.4 Reagents—For field-processing aliquots for trivalent chromium determinations

7.4.1 Nitric Acid, Ultrapure—For use when field-preserving samples for trivalent chromium determinations (Sections 6.17 and 8.4.4).

7.4.2 Ammonium Iron (II) Sulfate Solution (0.01M)—Used to prepare the chromium (III) extraction solution (Section 7.4.3) necessary for field preservation of samples for trivalent chromium (Section 8.4.4). Prepare the ammonium iron (II) sulfate solution by adding 3.92 g ammonium iron (II) sulfate (ultrapure grade) to a 1 L volumetric flask. Bring to volume with reagent water. Store in a clean polyethylene bottle.

7.4.3 Chromium (III) extraction solution—For use when field-preserving samples for trivalent chromium determinations (Section 8.4.4). Prepare this solution by adding 100 mL of ammonium iron (II) sulfate solution (Section 7.4.2) to a 125 mL polyethylene bottle. Adjust pH to 8 with approximately 2 mL of ammonium hydroxide solution. Cap and shake on a wrist-action shaker for 24 hours. This iron (III) hydroxide solution is stable for 30 days.

7.4.4 Hydrochloric acid—High-purity, 10% solution, shipped with sampling kit in fluoropolymer wash bottles for cleaning trivalent chromium sample preservation equipment between samples.

7.4.5 Chromium stock standard solution (1000 µg/mL)—Prepared by adding 3.1 g anhydrous chromium chloride to a 1 L flask and diluting to volume with 1% hydrochloric acid. Store in polyethylene bottle. A commercially available standard solution may be substituted.

7.4.6 Standard chromium spike solution (1000 µg/L)—Used to spike sample aliquots for matrix spike/matrix spike duplicate (MS/MSD) analysis and to prepare ongoing precision and recovery standards. Prepared by spiking 1 mL of the chromium stock standard solution (Section 7.4.5) into a 1 L flask. Dilute to volume with 1% HCl. Store in a polyethylene bottle.

7.4.7 Ongoing precision and recovery (OPR) standard (25 µg/L)—Prepared by spiking 2.5 mL of the standard chromium spike solution (Section 7.4.6) into a 100 mL flask. Dilute to volume with 1% HCl. One OPR is required for every 10 samples.

8.0 Sample Collection, Filtration, and Handling

8.1 Site Selection

8.1.1 Selection of a representative site for surface water sampling is based on many factors including: study objectives, water use, point source discharges, non-point source discharges, tributaries, changes in stream characteristics, types of stream bed, stream depth, turbulence, and the presence of structures (bridges, dams, etc.). When collecting samples to determine ambient levels of trace metals, the presence of potential sources of metal contamination are of extreme importance in site selection.

8.1.2 Ideally, the selected sampling site will exhibit a high degree of cross-sectional homogeneity. It may be possible to use previously collected data to identify locations for samples that are well mixed or are vertically or horizontally stratified. Since mixing is principally governed by turbulence and water velocity, the selection of a site immediately downstream of a riffle area will ensure good vertical mixing. Horizontal mixing occurs in constrictions in the channel. In the absence of turbulent areas, the selection of a site that is clear of immediate point sources, such as industrial effluents, is preferred for the collection of ambient water samples (Reference 19).

8.1.3 To minimize contamination from trace metals in the atmosphere, ambient water samples should be collected from sites that are as far as possible (e.g., at least several hundred feet) from any metal supports, bridges, wires or poles. Similarly, samples should be collected as far as possible from regularly or heavily traveled roads. If it is not possible to avoid collection near roadways, it is advisable to study traffic patterns and plan sampling events during lowest traffic flow (Reference 7).

8.1.4 The sampling activity should be planned to collect samples known or suspected to contain the lowest concentrations of trace metals first, finishing with the samples known or suspected to contain the highest concentrations. For example, if samples are collected from a flowing river or stream near an industrial or municipal discharge, the upstream sample should be collected first, the downstream sample collected second, and the sample nearest the discharge collected last. If the concentrations of pollutants is not known and cannot be estimated, it is necessary to use precleaned sampling equipment at each sampling location.

8.2 Sample Collection Procedure—Before collecting ambient water samples, consideration should be given to the type of sample to be collected, the amount of sample needed, and the devices to be used (grab, surface, or subsurface samplers). Sufficient sample volume should be collected to allow for necessary quality control analyses, such as matrix spike / matrix spike duplicate analyses.

8.2.1 Four sampling procedures are described:

8.2.1.1 Section 8.2.5 describes a procedure for collecting samples directly into the sample container. This procedure is the simplest and provides the least potential for contamination because it requires the least amount of equipment and handling.

8.2.1.2 Section 8.2.6 describes a procedure for using a grab sampling device to collect samples.

8.2.1.3 Section 8.2.7 describes a procedure for depth sampling with a jar sampler. The size of sample container used is dependent on the amount of sample needed by the analytical laboratory.

8.2.1.4 Section 8.2.8 describes a procedure for continuous-flow sampling using a submersible or peristaltic pump.

8.2.2 The sampling team should ideally approach the site from down current and downwind to prevent contamination of the sample by particles sloughing off the boat or equipment. If it is not possible to approach from both, the site should be approached from down current if sampling from a boat or approached from downwind if sampling on foot. When sampling from a boat, the bow of the boat should be oriented into the current (the boat will be pointed upstream). All sampling activity should occur from the bow.

If the samples are being collected from a boat, it is recommended that the sampling team create a stable workstation by arranging the cooler or shipping container as a work table on the upwind side of the boat, covering this worktable and the upwind gunnel with plastic wrap or a plastic tablecloth, and draping the wrap or cloth over the gunnel. If necessary, duct tape is used to hold the wrap or cloth in place.

8.2.3 All operations involving contact with the sample bottle and with transfer of the sample from the sample collection device to the sample bottle (if the sample is not directly collected in the bottle) are handled by the individual designated as "clean hands." "Dirty hands" is responsible for all activities that do not involve direct contact with the sample.

Although the duties of "clean hands" and "dirty hands" would appear to be a logical separation of responsibilities, in fact, the completion of the entire protocol may require a good deal of coordination and practice. For example, "dirty hands" must open the box or cooler containing the sample bottle and unzip the outer bag; clean hands must reach into the outer bag, open the inner bag, remove the bottle, collect the sample, replace the bottle lid, put the bottle back into the inner bag, and zip the inner bag. "Dirty hands" must close the outer bag and place it in a cooler.

To minimize unnecessary confusion, it is recommended that a third team member be available to complete the necessary sample documentation (e.g., to document sampling location, time, sample number, etc). Otherwise, "dirty hands" must perform the sample documentation activity (Reference 7).

8.2.4 Extreme care must be taken during all sampling operations to minimize exposure of the sample to human, atmospheric, and other sources of contamination. Care must be taken to avoid breathing directly on the sample, and whenever possible, the sample bottle should be opened, filled, and closed while submerged.

8.2.5 Manual collection of surface samples directly into the sample bottle.

8.2.5.1 At the site, all sampling personnel must put on clean gloves (Section 6.7) before commencing sample collection activity, with "clean hands" donning shoulder-length gloves. If samples are to be analyzed for mercury, the sampling team must also put their precleaned wind suits on at this time. Note that "clean hands" should put on the shoulder-length polyethylene gloves (Section 6.7.1) and both "clean hands" and "dirty hands" should put on the PVC gloves (Section 6.7.2).

8.2.5.2 "Dirty hands" must open the cooler or storage container, remove the double-bagged sample bottle from storage, and unzip the outer bag.

8.2.5.3 Next, "clean hands" opens the inside bag containing the sample bottle, removes the bottle, and reseals the inside bag. "Dirty hands" then reseals the outer bag.

8.2.5.4 "Clean hands" unscrews the cap and, while holding the cap upside down, discards the dilute acid solution from the bottle into a carboy for wastes (Section 6.16) or discards the reagent water directly into the water body.

8.2.5.5 "Clean hands" then submerges the sample bottle, and allows the bottle to partially fill with sample. "Clean hands" screws the cap on the bottle, shakes the bottle several times, and empties the rinsate away from the site. After two more rinsings, "clean hands" holds the bottle under water and allows bottle to fill with sample. After the bottle has filled (i.e., when no more bubbles appear), and while the bottle is still inverted so that the mouth of the bottle is underwater, "clean hands" replaces the cap of the bottle. In this way, the sample has never contacted the air.

8.2.5.6 Once the bottle lid has been replaced, "dirty hands" reopens the outer plastic bag, and "clean hands" opens the inside bag, places the bottle inside it, and zips the inner bag.

8.2.5.7 "Dirty hands" zips the outer bag.

8.2.5.8 Documentation—After each sample is collected, the sample number is documented in the sampling log, and any unusual observations concerning the sample and the sampling are documented.

8.2.5.9 If the sample is to be analyzed for dissolved metals, it is filtered in accordance with the procedure described in Section 8.3.

8.2.6 Sample collection with grab sampling device—The following steps detail sample collection using the grab sampling device shown in Figure 1 and described in Section 6.4.1. The procedure is indicative of the "clean hands/dirty hands" technique that must be used with alternative grab sampling devices such as that shown in Figure 2 and described in Section 6.4.2.

8.2.6.1 The sampling team puts on gloves (and wind suits, if applicable). Ideally, a sample bottle will have been preattached to the sampling device in the class 100 clean room at the laboratory. If it is necessary to attach a bottle to the device in the field, "clean hands" performs this operation, described in Section 6.4.2, inside the field-portable glove bag (Section 6.6).

8.2.6.2 "Dirty hands" removes the sampling device from its storage container and opens the outer polyethylene bag.

8.2.6.3 "Clean hands" opens the inside polyethylene bag and removes the sampling device.

8.2.6.4 "Clean hands" changes gloves.

8.2.6.5 "Dirty hands" submerges the sampling device to the desired depth and pulls the fluoropolymer pull cord to bring the seal plate into the middle position so that water can enter the bottle.

8.2.6.6 When the bottle is full (i.e., when no more bubbles appear), "dirty hands" pulls the fluoropolymer cord to the final stop position to seal off the sample and removes the sampling device from the water.

8.2.6.7 "Dirty hands" returns the sampling device to its large inner plastic bag, "clean hands" pulls the bottle out of the collar, unscrews the bottle from the sealing device, and caps the bottle. "Clean hands" and "dirty hands" then return the bottle to its double-bagged storage as described in Sections 8.2.5.6 through 8.2.5.7.

8.2.6.8 Closing mechanism—"Clean hands" removes the closing mechanism from the body of the grab sampler, rinses the device with reagent water (Section 7.1), places it inside a new clean plastic bag, zips the bag, and places the bag inside an outer bag held by "dirty hands." "Dirty hands" zips the outer bag and places the double-bagged closing mechanism in the equipment storage box.

8.2.6.9 Sampling device—"Clean hands" seals the large inside bag containing the collar, pole, and cord and places the bag into a large outer bag held by "dirty hands." "Dirty hands" seals the outside bag and places the double-bagged sampling device into the equipment storage box.

8.2.6.10 Documentation—After each sample is collected, the sample number is documented in the sampling log, and any unusual observations concerning the sample and the sampling are documented.

8.2.6.11 If the sample is to be analyzed for dissolved metals, it is filtered in accordance with the procedures described in Section 8.3.

8.2.7 Depth sampling using a jar sampling device (Figure 3 and Section 6.5.1)

8.2.7.1 The sampling team puts on gloves (and wind suits, if applicable) and handles bottles as with manual collection (Sections 8.2.5.1 through 8.2.5.4 and 8.2.5.6 through 8.2.5.7).

8.2.7.2 "Dirty hands" removes the jar sampling device from its storage container and opens the outer polyethylene bag.

8.2.7.3 "Clean hands" opens the inside polyethylene bag and removes the jar sampling apparatus. Ideally, the sampling device will have been preassembled in a class 100 clean room at the laboratory. If, however, it is necessary to assemble the device in the field, "clean hands" must perform this operation, described in Section 6.5.2, inside a field-portable glove bag (Section 6.6).

8.2.7.4 While "dirty hands" is holding the jar sampling apparatus, "clean hands" connects the pump to the to the 1/4 in. o.d. flush line.

8.2.7.5 "Dirty hands" lowers the weighted sampler to the desired depth.

8.2.7.6 "Dirty hands" turns on the pump allowing a large volume (>2 L) of water to pass through the system.

8.2.7.7 After stopping the pump, "dirty hands" pulls up the line, tubing, and device and places them into either a field-portable glove bag or a large, clean plastic bag as they emerge.

8.2.7.8 Both "clean hands" and "dirty hands" change gloves.

8.2.7.9 Using the technique described in Sections 8.2.5.2 through 8.2.5.4, the sampling team removes a sample bottle from storage, and "clean hands" places the bottle into the glove bag.

8.2.7.10 "Clean hands" tips the sampling jar and dispenses the sample through the short length of fluoropolymer tubing into the sample bottle.

8.2.7.11 Once the bottle is filled, "clean hands" replaces the cap of the bottle, returns the bottle to the inside polyethylene bag, and zips the bag. "Clean hands" returns the zipped bag to the outside polyethylene bag held by "dirty hands."

8.2.7.12 "Dirty hands" zips the outside bag. If the sample is to be analyzed for dissolved metals, it is filtered as described in Section 8.3.

8.2.7.13 Documentation—After each sample is collected, the sample number is documented in the sampling log, and any unusual observations concerning the sample and the sampling are documented.

8.2.8 Continuous-flow sampling (Figure 4 and Section 6.5.2)—The continuous-flow sampling system uses peristaltic pump (Section 6.15) to pump sample to the boat or to shore through the SEBS-resin or PTFE tubing.

8.2.8.1 Before putting on wind suits or gloves, the sampling team removes the bags containing the pump (Section 6.15), SEBS-resin tubing (Section 6.15.2), batteries (Section 6.15.4), gloves (Section 6.7), plastic wrap (Section 6.9), wind suits (Section 6.12), and, if samples are to be filtered, the filtration apparatus (Section 6.14) from the coolers or storage containers in which they are packed.

8.2.8.2 "Clean hands" and "dirty hands" put on the wind suits and PVC gloves (Section 6.7.2).

8.2.8.3 "Dirty hands" removes the pump from its storage bag, and opens the bag containing the SEBS-resin tubing.

8.2.8.4 "Clean hands" installs the tubing while "dirty hands" holds the pump. "Clean hands" immerses the inlet end of the tubing in the sample stream.

8.2.8.5 Both "clean hands" and "dirty hands" change gloves. "Clean hands" also puts on shoulder length polyethylene gloves (Section 6.7.1).

8.2.8.6 "Dirty hands" turns the pump on and allows the pump to run for 5-10 minutes or longer to purge the pump and tubing.

8.2.8.7 If the sample is to be filtered, "clean hands" installs the filter at the end of the tubing, and "dirty hands" sets up the filter holder on the gunwale as shown in Figure 4.

NOTE: *The filtration apparatus is not attached until immediately before sampling to prevent buildup of particulates from clogging the filter.*

8.2.8.8 The sample is collected by rinsing the sample bottle and cap three times and collecting the sample from the flowing stream.

8.2.8.9 Documentation—After each sample is collected, the sample number is documented in the sampling log, and any unusual observations concerning the sample and the sampling are documented.

8.3 Sample Filtration—The filtration procedure described below is used for samples collected using the manual (Section 8.2.5), grab (Section 8.2.6), or jar (Section 8.2.7) collection systems (Reference 7). In-line filtration using the continuous-flow approach is described in Section 8.2.8.7. Because of the risk of contamination, it is recommended that samples for mercury be shipped unfiltered by overnight courier and filtered when received at the laboratory.

8.3.1 Set up the filtration system inside the glove bag, using the shortest piece of pump tubing as is practicable. Place the peristaltic pump immediately outside of the glove bag and poke a small hole in the glove bag for passage of the tubing. Also, attach a short length of tubing to the outlet of the capsule filter.

8.3.2 "Clean hands" removes the water sample from the inner storage bag using the technique described in Sections 8.2.5.2 through 8.2.5.4 and places the sample inside the glove bag. "Clean hands" also places two clean empty sample bottles, a bottle containing reagent water, and a bottle for waste in the glove bag.

8.3.3 "Clean hands" removes the lid of the reagent water bottle and places the end of the pump tubing in the bottle.

8.3.4 "Dirty hands" starts the pump and passes approximately 200 mL of reagent water through the tubing and filter into the waste bottle. "Clean hands" then moves the outlet tubing to a clean bottle and collects the remaining reagent water as a blank. "Dirty hands" stops the pump.

8.3.5 "Clean hands" removes the lid of the sample bottle and places the intake end of the tubing in the bottle.

8.3.6 "Dirty hands" starts the pump and passes approximately 50 mL through the tubing and filter into the remaining clean sample bottle and then stops the pump. "Clean hands" uses the filtrate to rinse the bottle, discards the waste sample, and returns the outlet tube to the sample bottle.

8.3.7 "Dirty hands" starts the pump and the remaining sample is processed through the filter and collected in the sample bottle. If preservation is required, the sample is acidified at this point (Section 8.4).

8.3.8 "Clean hands" replaces the lid on the bottle, returns the bottle to the inside bag, and zips the bag. "Clean hands" then places the zipped bag into the outer bag held by "dirty hands."

8.3.9 "Dirty hands" zips the outer bag, and places the double-bagged sample bottle into a clean, ice-filled cooler for immediate shipment to the laboratory.

NOTE: *It is not advisable to reclean and reuse filters. The difficulty and risk associated with failing to properly clean these devices far outweighs the cost of purchasing a new filter.*

8.4 Preservation

8.4.1 Field preservation is not necessary for dissolved metals, except for trivalent and hexavalent chromium, provided that the sample is preserved in the laboratory and allowed to stand for at least two days to allow the metals adsorbed to the container walls to redissolve. Field preservation is advised for hexavalent chromium in order to provide sample stability for up to 30 days. Mercury samples should be shipped by overnight courier and preserved when received at the laboratory.

8.4.2 If field preservation is required, preservation must be performed in the glove bag or in a designated clean area, with gloved hands, as rapidly as possible to preclude particulates from contaminating the sample. For preservation of trivalent chromium, the glove bag or designated clean area must be large enough to accommodate the vacuum filtration apparatus (Section 6.17.3), and an area should be available for setting up the wrist-action shaker (Section 6.17.5). It is also advisable to set up a work area that contains a "clean" cooler for storage of clean equipment, a "dirty" cooler for storage of "dirty" equipment, and a third cooler to store samples for shipment to the laboratory.

8.4.3 Preservation of aliquots for metals other than trivalent and hexavalent chromium—Using a disposable, precleaned, plastic pipet, add 5 mL of a 10% solution of ultrapure nitric acid in reagent water per liter of sample. This will be sufficient to preserve a neutral sample to pH <2.

8.4.4 Preservation of aliquots for trivalent chromium (References 8-9).

8.4.4.1 Decant 100 mL of the sample into a clean polyethylene bottle.

8.4.4.2 Clean an Eppendorf pipet by pipeting 1 mL of 10% HCl (Section (7.4.4) followed by 1 mL of reagent water into an acid waste container. Use the rinsed pipet to add 1 mL of chromium (III) extraction solution (Section 7.4.3) to each sample and blank.

8.4.4.3 Cap each bottle tightly, place in a clean polyethylene bag, and shake on a wrist action shaker (Section 6.17.5) for one hour.

8.4.4.4 Vacuum-filter the precipitate through a 0.4 µm pretreated filter membrane (Section 6.17.2), using fluoropolymer forceps (Section 6.17.1) to handle the membrane, and a 47 mm vacuum filtration apparatus with a precleaned filter holder (Section 6.17.3). After all sample has filtered, rinse the inside of the filter holder with approximately 15 mL of reagent water.

8.4.4.5 Using the fluoropolymer forceps, fold the membrane in half and then in quarters, taking care to avoid touching the side containing the filtrate to any surface. (Folding is done while the membrane is sitting on the filter holder and allows easy placement of the membrane into the sample vial). Transfer the filter to a 30 mL fluoropolymer vial. If the fluoropolymer vial was not pre-equipped with the ultrapure nitric acid (Section 7.4.1), rinse the pipet by drawing and discharging 1 mL of 10% HCl followed by 1 mL of reagent water into a waste container, and add 1 mL of ultrapure nitric acid to the sample vial.

8.4.4.6 Cap the vial and double-bag it for shipment to the laboratory.

8.4.4.7 Repeat Steps 8.4.4.4-8.4.4.6 for each sample, rinsing the fluoropolymer forceps and the pipet with 10% high-purity HCl followed by reagent water between samples.

8.4.5 Preservation of aliquots for hexavalent chromium (Reference 20).

8.4.5.1 Decant 125 mL of sample into a clean polyethylene bottle.

8.4.5.2 Prepare an Eppendorf pipet by pipeting 1 mL of 10% HCl (Section 7.4.4) followed by 1 mL of reagent water into an acid waste container. Use the rinsed pipet to add 1 mL NaOH to each 125 mL sample and blank aliquot.

8.4.5.3 Cap the vial(s) and double-bag for shipment to the laboratory.

9.0 Quality Assurance/Quality Control

9.1 The sampling team shall employ a strict quality assurance/ quality control (QA/QC) program. The minimum requirements of this program include the collection of equipment blanks, field blanks, and field replicates. It is also desirable to include blind QC samples as part of the program. If samples will be processed for trivalent chromium determinations, the sampling team shall also prepare method blank, OPR, and MS/MSD samples as described in Section 9.6.

9.2 The sampling team is permitted to modify the sampling techniques described in this method to improve performance or reduce sampling costs, provided that reliable analyses of samples are obtained and that samples and blanks are not contaminated. Each time a modification is made to the procedures, the sampling team is required to demonstrate that the modification does not result in contamination of field and equipment blanks. The requirements for modification are given in Sections 9.3 and 9.4. Because the acceptability of a modification is based on the results obtained with the modification, the sampling team must work with an analytical laboratory capable of making trace metals determinations to demonstrate equivalence.

9.3 Equipment Blanks

9.3.1 Before using any sampling equipment at a given site, the laboratory or equipment cleaning contractor is required to generate equipment blanks to demonstrate that the equipment is free from contamination. Two types of equipment blanks are required: bottle blanks and sampling equipment blanks.

9.3.2 Equipment blanks must be run on all equipment that will be used in the field. If, for example, samples are to be collected using both a grab sampling device and the jar sampling device, then an equipment blank must be run on both pieces of equipment.

9.3.3 Equipment blanks are generated in the laboratory or at the equipment cleaning contractor's facility by processing reagent water through the equipment using the same procedures that are used in the field (Section 8.0). Therefore, the "clean hands/dirty hands" technique used during field sampling should be followed when preparing equipment blanks at the laboratory or cleaning facility. In addition, training programs must require must require sampling personnel to collect a clean equipment blank before performing on-site field activities.

9.3.4 Detailed procedures for collecting equipment blanks are given in the analytical methods referenced in Table 1.

9.3.5 The equipment blank must be analyzed using the procedures detailed in the referenced analytical method (see Table 1). If any metal(s) of interest or any potentially interfering substance is detected in the equipment blank at the minimum level specified in the referenced method, the source of contamination/interference must be identified and removed. The equipment must be demonstrated to be free from the metal(s) of interest before the equipment may be used in the field.

9.4 Field Blank

9.4.1 To demonstrate that sample contamination has not occurred during field sampling and sample processing, at least one field blank must be generated for every 10 samples that are collected at a given site. Field blanks are collected before sample collection.

9.4.2 Field blanks are generated by filling a large carboy or other appropriate container with reagent water (Section 7.1) in the laboratory, transporting the filled container to the sampling site, processing the water through each of the sample processing steps and equipment (e.g., tubing, sampling devices, filters, etc.) that will be used in the field, collecting the field blank in one of the sample bottles, and shipping the bottle to the laboratory for analysis in accordance with the method(s) referenced in Table 1. For example, manual grab sampler field blanks are collected by directly submerging a sample bottle into the water, filling the bottle, and capping. Subsurface sampler field blanks are collected by immersing the tubing into the water and pumping water into a sample container.

9.4.3 Filter the field blanks using the procedures described in Section 8.3.

9.4.4 If it is necessary to acid clean the sampling equipment between samples (Section 10.0), a field blank should be collected after the cleaning procedures but before the next sample is collected.

9.4.5 If trivalent chromium aliquots are processed, a separate field blank must be collected and processed through the sample preparation steps given in Sections 8.4.4.1 through 8.4.4.6.

9.5 Field Duplicate

9.5.1 To assess the precision of the field sampling and analytical processes, at least one field duplicate sample must be collected for every 10 samples that are collected at a given site.

9.5.2 The field duplicate is collected either by splitting a larger volume into two aliquots in the glove box, by using a sampler with dual inlets that allows simultaneous collection of two samples, or by collecting two samples in rapid succession.

9.5.3 Field duplicates for dissolved metals determinations must be processed using the procedures in Section 8.3. Field duplicates for trivalent chromium must be processed through the sample preparation steps given in Sections 8.4.4.1 through 8.4.4.6.

9.6 Additional QC for Collection of Trivalent Chromium Aliquots

9.6.1 Method blank—The sampling team must prepare one method blank for every ten or fewer field samples. Each method blank is prepared using the steps in Sections 8.4.4.1 through 8.4.4.6 on a 100 mL aliquot of reagent water (Section 7.1). Do not use the procedures in Section 8.3 to process the method blank through the 0.45 µm filter (Section 6.14.1), even if samples are being collected for dissolved metals determinations.

9.6.2 Ongoing precision and recovery (OPR)—The sampling team must prepare one OPR for every ten or fewer field samples. The OPR is prepared using the steps in Sections 8.4.4.1 through 8.4.4.6 on the OPR standard (Section 7.4.7). Do not use the procedures in Section 8.3 to process the OPR through the 0.45 µm filter (Section 6.14.1), even if samples are being collected for dissolved metals determinations.

9.6.3 MS/MSD—The sampling team must prepare one MS and one MSD for every ten or fewer field samples.

9.6.3.1 If, through historical data, the background concentration of the sample can be estimated, the MS and MSD samples should be spiked at a level of one to five times the background concentration.

9.6.3.2 For samples in which the background concentration is unknown, the MS and MSD samples should be spiked at a concentration of 25 µg/L.

9.6.3.3 Prepare the matrix spike sample by spiking a 100-mL aliquot of sample with 2.5 mL of the standard chromium spike solution (Section 7.4.6), and processing the MS through the steps in Sections 8.4.4.1 through 8.4.4.6.

9.6.3.4 Prepare the matrix spike duplicate sample by spiking a second 100-mL aliquot of the same sample with 2.5 mL of the standard chromium spike solution, and processing the MSD through the steps in Sections 8.4.4.1 through 8.4.4.6.

9.6.3.5 If field samples are collected for dissolved metals determinations, it is necessary to process an MS and an MSD through the 0.45 µm filter as described in Section 8.3.

10.0 Recleaning the Apparatus Between Samples

10.1 Sampling activity should be planned so that samples known or suspected to contain the lowest concentrations of trace metals are collected first with the samples known or suspected to contain the highest concentrations of trace metals collected last. In this manner, cleaning of the sampling equipment between samples in unnecessary. If it is not possible to plan sampling activity in this manner, dedicated sampling equipment should be provided for each sampling event.

10.2 If samples are collected from adjacent sites (e.g., immediately upstream or downstream), rinsing of the sampling Apparatus with water that is to be sampled should be sufficient.

10.3 If it is necessary to cross a gradient (i.e., going from a high-concentration sample to a low-concentration sample), such as might occur when collecting at a second site, the following procedure may be used to clean the sampling equipment between samples:

10.3.1 In the glove bag, and using the "clean hands/dirty hands" procedure in Section 8.2.5, process the dilute nitric acid solution (Section 7.2) through the Apparatus.

10.3.2 Dump the spent dilute acid in the waste carboy or in the waterbody away from the sampling point.

10.3.3 Process 1 L of reagent water through the Apparatus to rinse the equipment and discard the spent water.

10.3.4 Collect a field blank as described in Section 9.4.

10.3.5 Rinse the Apparatus with copious amounts of the ambient water sample and proceed with sample collection.

10.4 Procedures for recleaning trivalent chromium preservation equipment between samples are described in Section 8.4.4.

11.0 Method Performance

Samples were collected in the Great Lakes during September–October 1994 using the procedures in this sampling method.

12.0 Pollution Prevention

12.1 The only materials used in this method that could be considered pollutants are the acids used in the cleaning of the Apparatus, the boat, and related materials. These acids are used in dilute solutions in small amounts and pose little threat to the environment when managed properly.

12.2 Cleaning solutions containing acids should be prepared in volumes consistent with use to minimize the disposal of excessive volumes of acid.

12.3 To the extent possible, the Apparatus used to collect samples should be cleaned and reused to minimize the generation of solid waste.

13.0 Waste Management

13.1 It is the sampling team's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the discharge regulations, hazardous waste identification rules, and land disposal restrictions; and to protect the air, water, and land by minimizing and controlling all releases from field operations.

13.2 For further information on waste management, consult *The Waste Management Manual for Laboratory Personnel* and *Less is Better—Laboratory Chemical Management for Waste Reduction*, available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street NW, Washington, DC 20036.

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15.0 Glossary of Definitions and Purposes

These definitions and purposes are specific to this sampling method but have been conformed to common usage as much as possible.

15.1 Ambient Water—Waters in the natural environment (e.g., rivers, lakes, streams, and other receiving waters), as opposed to effluent discharges.

15.2 Apparatus—The sample container and other containers, filters, filter holders, labware, tubing, pipets, and other materials and devices used for sample collection or sample preparation, and that will contact samples, blanks, or analytical standards.

15.3 Equipment Blank—An aliquot of reagent water that is subjected in the laboratory to all aspects of sample collection and analysis, including contact with all sampling devices and apparatus. The purpose of the equipment blank is to determine if the sampling devices and apparatus for sample collection have been adequately cleaned before they are shipped to the field site. An acceptable equipment blank must be achieved before the sampling devices and Apparatus are used for sample collection.

15.4 Field Blank—An aliquot of reagent water that is placed in a sample container in the laboratory, shipped to the field, and treated as a sample in all respects, including contact with the sampling devices and exposure to sampling site conditions, filtration, storage, preservation, and all analytical procedures. The purpose of the field blank is to determine whether the field or sample transporting procedures and environments have contaminated the sample.

15.5 Field Duplicates (FD1 and FD2)—Two identical aliquots of a sample collected in separate sample bottles at the same time and place under identical circumstances using a duel inlet sampler or by splitting a larger aliquot and treated exactly the same throughout field and laboratory procedures. Analyses of FD1 and FD2 give a measure of the precision associated with sample collection, preservation, and storage, as well as with laboratory procedures.

15.6 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)—Aliquots of an environmental sample to which known quantities of the analytes are added in the laboratory. The MS and MSD are analyzed exactly like a sample. Their purpose is to quantify the bias and precision caused by the sample matrix. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MS and MSD corrected for background concentrations.

15.7 May—This action, activity, or procedural step is optional.

15.8 May Not—This action, activity, or procedural step is prohibited.

15.9 Minimum Level (ML)—The lowest level at which the entire analytical system gives a recognizable signal and acceptable calibration point (Reference 21).

15.10 Must—This action, activity, or procedural step is required.

15.11 Reagent Water—Water demonstrated to be free from the metal(s) of interest and potentially interfering substances at the MDL for that metal in the referenced method or additional method.

15.12 Should—This action, activity, or procedural step is suggested but not required.

15.13 Trace-Metal Grade—Reagents that have been demonstrated to be free from the metal(s) of interest at the method detection limit (MDL) of the analytical method to be used for determination of this metal(s).

The term "trace-metal grade" has been used in place of "reagent grade" or "reagent" because acids and other materials labeled "reagent grade" have been shown to contain concentrations of metals that will interfere in the determination of trace metals at levels listed in Table 1.

TABLE 1. ANALYTICAL METHODS, METALS, AND CONCENTRATION LEVELS APPLICABLE TO METHOD 1669

Method	Technique	Metal	MDL (µg/L) [1]	ML (µg/L) [2]
1631	Oxidation/Purge & Trap/CVAFS	Mercury	0.0002	0.0005
1632	Hydride AA	Arsenic	0.003	0.01
1636	Ion Chromatography	Hexavalent Chromium	0.23	0.5
1637	CC/STGFAA	Cadmium	0.0075	0.02
		Lead	0.036	0.1
1638	ICP/MS	Antimony	0.0097	0.02
		Cadmium	0.013	0.1
		Copper	0.087	0.2
		Lead	0.015	0.05
		Nickel	0.33	1
		Selenium	0.45	1
		Silver	0.029	0.1
		Thallium	0.0079	0.02
		Zinc	0.14	0.5
1639	STGFAA	Antimony	1.9	5
		Cadmium	0.023	0.05
		Trivalent Chromium	0.10	0.2
		Nickel	0.65	2
		Selenium	0.83	2
		Zinc	0.14	0.5
1640	CC/ICP/MS	Cadmium	0.0024	0.01
		Copper	0.024	0.1
		Lead	0.0081	0.02
		Nickel	0.029	0.1

[1] Method Detection Limit as determined by 40 *CFR* Part 136, Appendix B.
[2] Minimum Level (ML) calculated by multiplying laboratory-determined MDL by 3.18 and rounding result to nearest multiple of 1, 2, 5, 10, 20, 50, etc., in accordance with procedures used by EAD and described in the EPA *Draft National Guidance for the Permitting, Monitoring, and Enforcement of Water Quality-Based Effluent Limitations Set Below Analytical Detection/Quantitation Levels*, March 22, 1994.

TABLE 2. ANALYTES, PRESERVATION REQUIREMENTS, AND CONTAINERS

Metal	Preservation Requirements	Acceptable Containers
Antimony Arsenic Cadmium Copper Lead Nickel Selenium Silver Thallium Zinc	Add 5 mL of 10% $HN0_3$ to 1-L sample; preserve on-site or immediately upon laboratory receipt.	500 mL or 1 L fluoropolymer, conventional or linear polyethylene, polycarbonate, or polypropylene containers with lid
Chromium (III)	Add 1 mL chromium (III) extraction solution to 100 mL aliquot, vacuum filter through 0.4 µm membrane, add 1 mL 10% $HN0_3$; preserve on-site immediately after collection.	500 mL or 1 L fluoropolymer, conventional or linear polyethylene, polycarbonate, or polypropylene containers with lid
Chromium (IV)	Add 50% NaOH; preserve immediately after sample collection.	500 mL or 1 L fluoropolymer, conventional or linear polyethylene, polycarbonate, or polypropylene containers with lid
Mercury	Total: Add 0.5% high-purity HCl or 0.5% BrCl to pH < 2; Total & Methyl: Add 0.5% high-purity HCL; preserve on-site or immediately upon laboratory receipt	Fluoropolymer or borosilicate glass bottles with fluoropolymer or fluoropolymer-lined caps

Figure 1 - Grab Sampling Device

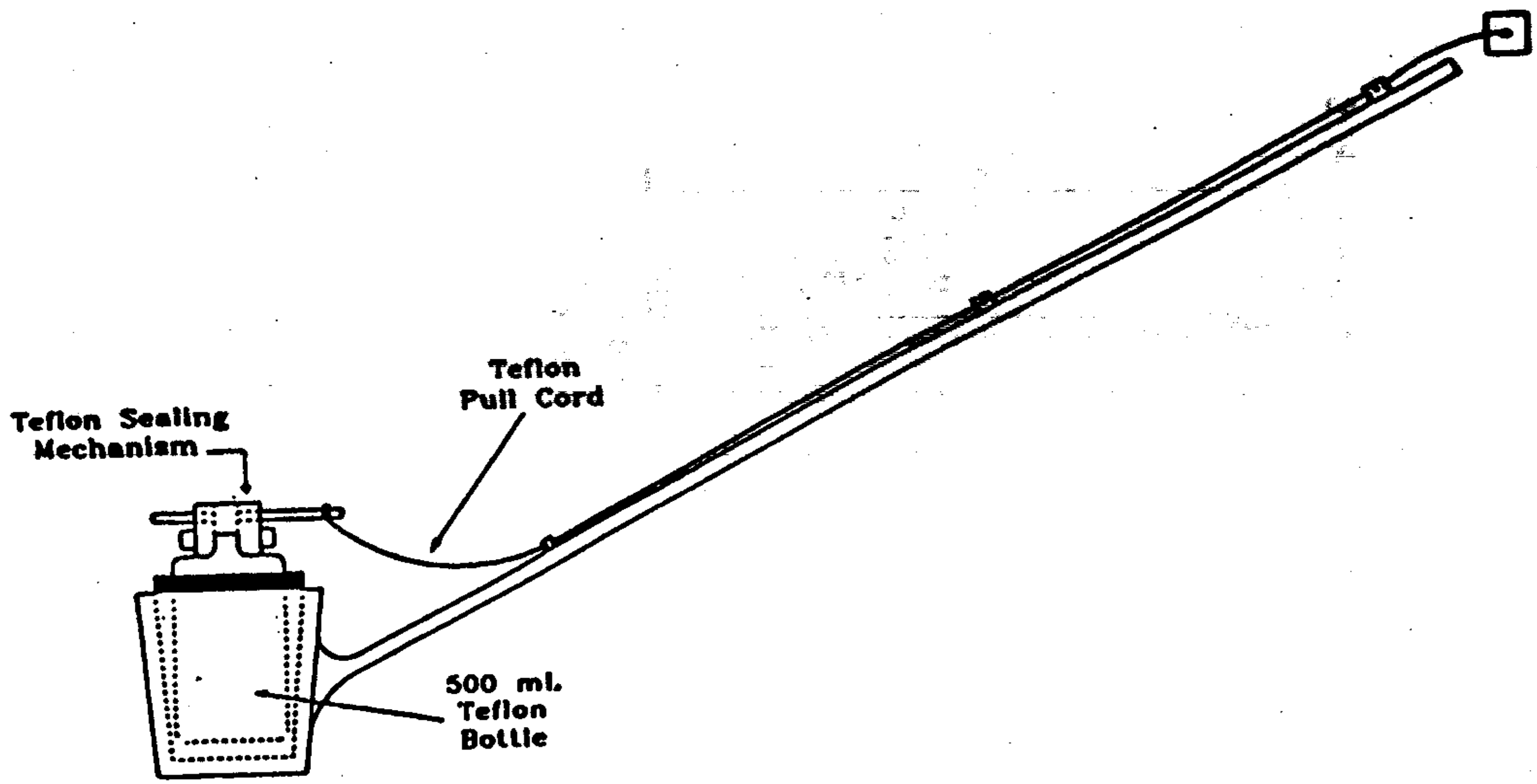


Figure 2 - Grab Sampling Device

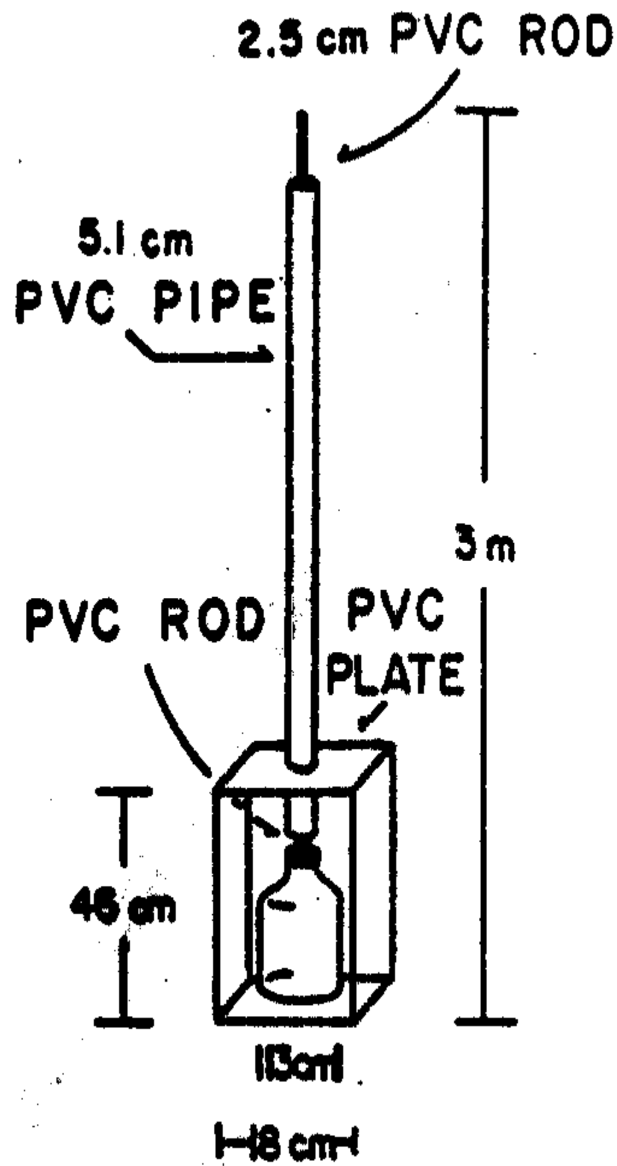


Figure 3 - Jar Sampling Device

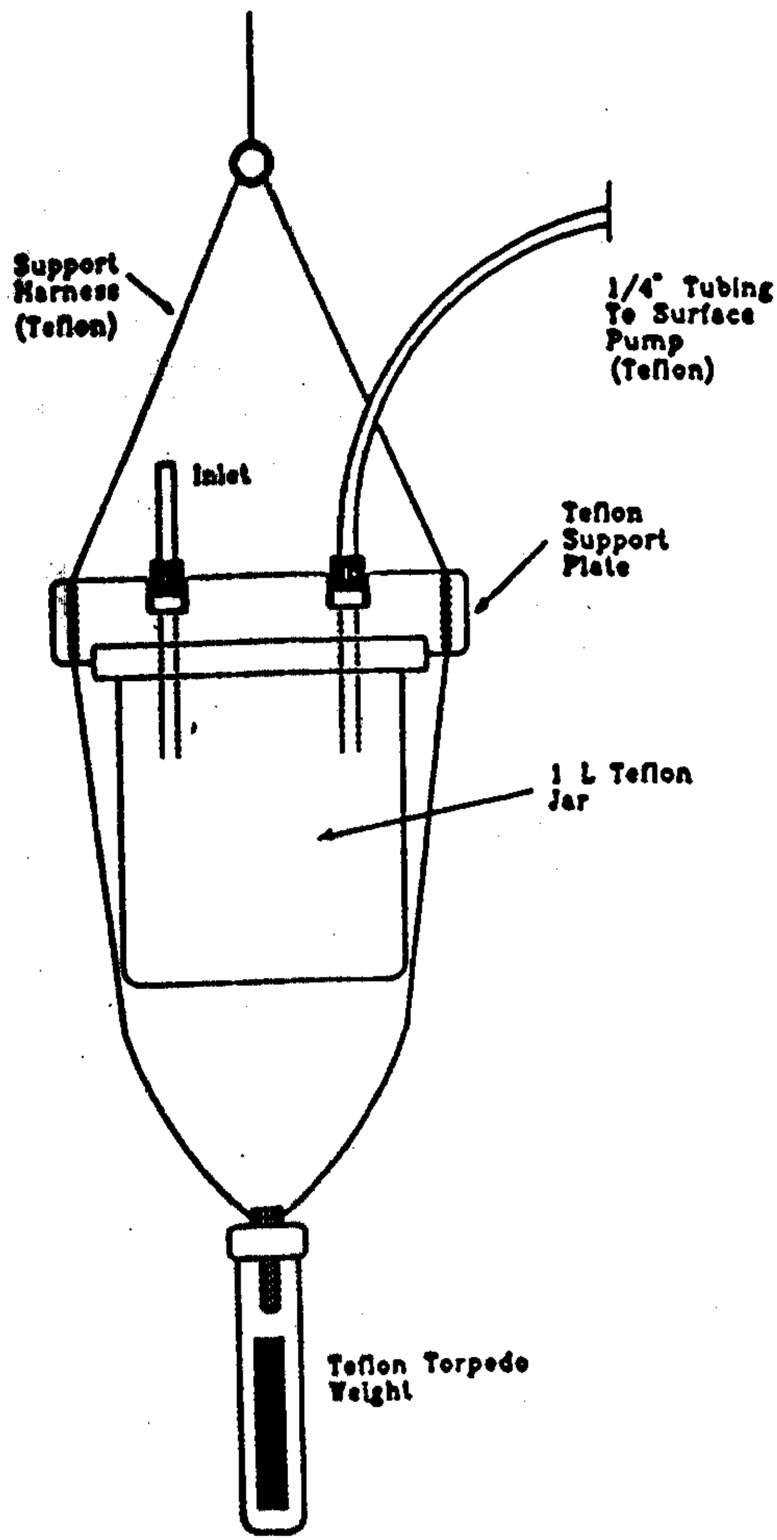
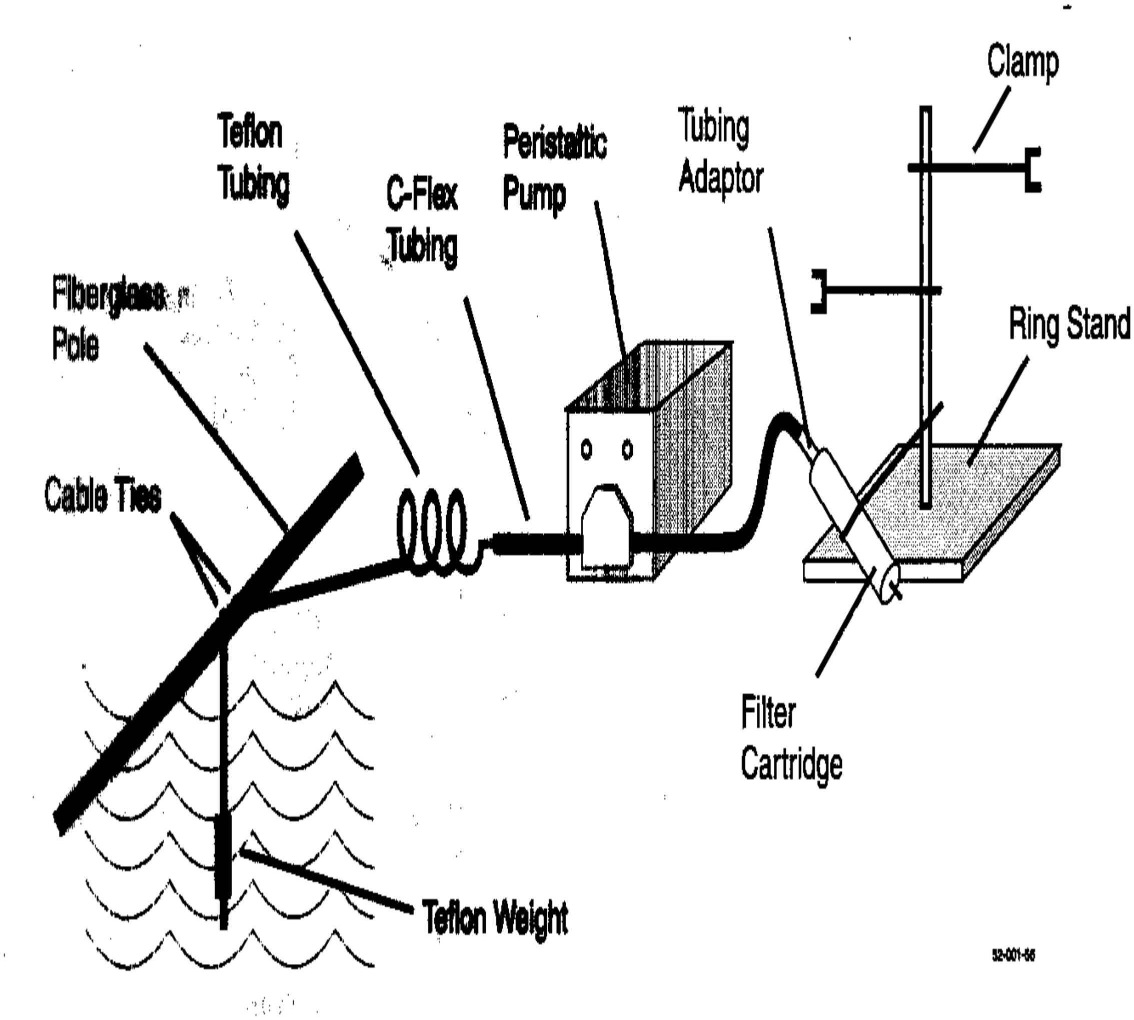


Figure 4 - Sample Pumping System



Attachment 3

In-Line Sediment Trap Sampling SOP

1. PURPOSE AND SCOPE

The following text describes the techniques that will be employed to collect in-line sediments at locations identified in the Pre-Design Investigation (PDI) Work Plan.

2. EQUIPMENT

To assess incoming contaminant loads and movement of settleable suspended solids, in-line sediment traps will be deployed and sampled. In-line sediment traps will be installed and retrieved in select locations as described in the PDI Work Plan.

In-line sediment traps addressed by this SOP include the deployment of four 1-Liter HDPE sample bottles held in place with a custom stainless-steel bracket. At each designated sampling location, in-line sediment traps will be installed at the bottom of the conveyance system. In-line sediment traps will be firmly secured to the conveyance system to prevent unintended transport of the equipment. All in-line sediment traps and related equipment will be decontaminated prior to installation.

The FMC Standard OS-8 Permit Required Confined Space Entry is included as Attachment A.

3. DEPLOYMENT OF SEDIMENT TRAPS

As identified in the PDI Work Plan, in-line sediment trap structures (Boston sediment trap) will be installed (Figure 1). Field crews will perform a confined space entry in accordance with FMC Standard OS-8 Permit Required Confined Space Entry (Attachment A) to install the sediment traps in the flow. A confined space entry will also be required to collect the sediment samples. Each of the 1-liter HDPE sample bottles with removeable Teflon®-lined lids will be held to the bottom of the pipe using custom stainless-steel hardware and brackets (Figure 2).

Sediment traps will be deployed at each location and the sample bottles will be retrieved at the intervals described in the PDI WP. When samples bottles are collected and archived, a clean bottle will be installed in the trap. Sediment samples will be capped, labeled, sealed, and submitted to the laboratory in accordance with the appropriate project planning documents. In general, procedures detailed in this SOP are adopted from the approved Portland Harbor RI/FS Stormwater Field Sampling Plan (LWG 2007; Appendix C).

Figure 1. Schematic of deployed Boston sediment trap.

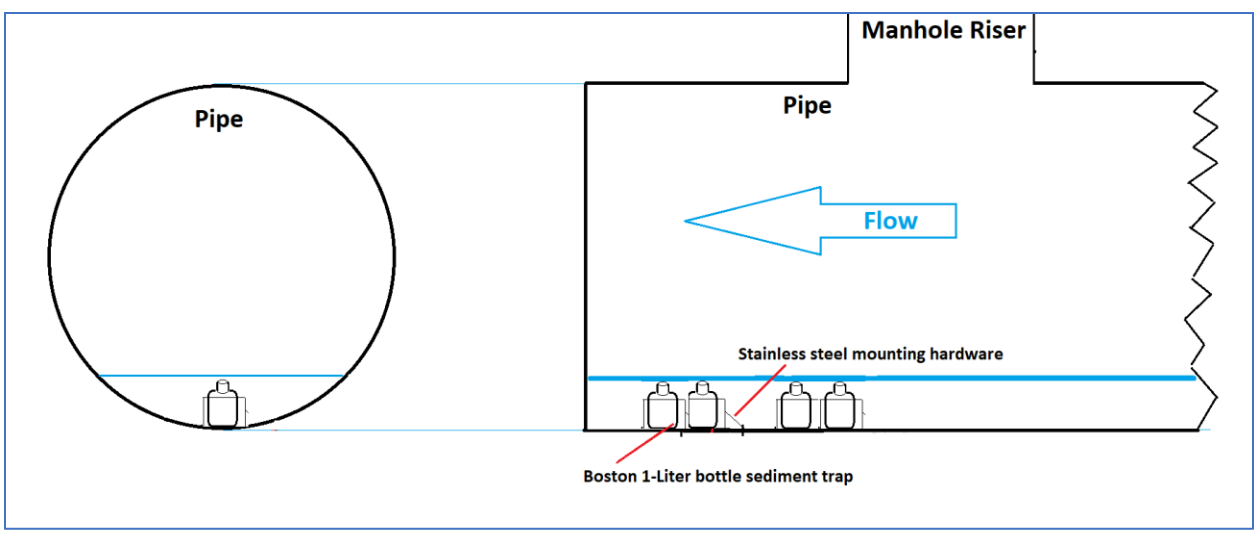


Figure 2. Installation photograph of example deployed sediment traps.

4. INSTALLATION METHODS

Experienced field personnel will install the in-line sediment traps using stainless steel hardware and using inert materials. A confined space entry will be required to install the in-line sediment traps. Where traffic controls are required, a traffic control permit will be obtained from the City of Portland. An encroachment permit from the City may also be required to install the in-line sediment traps.

When installing the brackets in the field at the sampling sites, field crews will clean the area around the stainless-steel anchor bolts to remove any concrete dust or debris. After the bolts are set or other procedures are complete, the work site will be scrubbed with a brush to remove any debris and rinsed with deionized water before the sampling hardware (sample bottle holder) is mounted. Care will be taken to capture the rinse water from the work area.

5. LIST OF EQUIPMENT NEEDED FOR IN-LINE SEDIMENT TRAP SAMPLING

The following equipment and supplies will be used for sediment sample collection:

- Photoionization detectors (PIDs)
- Confined space entry and personnel retrieval equipment
- Laboratory-supplied 1-Liter sample bottles
- Decontamination kit (buckets, brushes, Alconox, and tap and deionized water)
- Camera
- Sharpies/pens
- Labels
- Chain-of-Custody forms
- Ice and cooler
- Paper towels
- Personal protective equipment (PPE), including hard hat, boots, safety glasses, high-visibility vest, nitrile gloves, and ear plugs for drilling activities
- Confined space entry PPE per FMC Standard OS-8 Permit Required Confined Space Entry (Attachment A).

6. SEDIMENT RETRIEVAL METHODS

In accordance with the PDI WP, the sediment traps will be collected and archived in the analytical laboratory and a clean bottle will be installed to the trap bracket. The methods for retrieving the accumulated sediment are presented below. A confined space entry will be performed to retrieve sediment samples according to these instructions:

- Using safe lifting techniques, traffic controls (if needed), and implementing all health and safety protocols, open the manhole cover.
- Perform the confined space entry into the manhole and prepare to retrieve the sediment trap bottles.
- Implement "clean hands – dirty hands" method (EPA 1996; Attachment B) for collecting samples.
- Use phthalate-free vinyl gloves to place the Teflon lids on the sample bottles.
- Remove the sample bottle from the bracket and transfer each bottle to the surface.
- Label the bottle, pack on ice, and prepare for transport to the analytical laboratory.
- Place new laboratory-provided 1-Liter sample bottles back into the brackets, remove the lids, and store the lids in a phthalate-free bag.
- Exit the confined space and replace the manhole cover.

7. DECONTAMINATION PROCEDURES

Decontamination of sampling equipment must be conducted consistently to ensure the quality of samples collected. Disposable equipment intended for one-time use will not be decontaminated but will be packaged for appropriate disposal.

Decontamination will occur prior to each use of a piece of equipment. All sampling devices that potentially contact sampling media (grab pole, stainless beaker, cups, etc.) will be decontaminated according to EPA Region 10 recommended procedures (Attachment B). The following, to be carried out in sequence, is an EPA Region 10 recommended procedure for the decontamination of sampling equipment:

- Non-phosphate detergent and tap water wash, using a brush if necessary
- Tap water rinse
- Deionized/distilled water rinse (first rinse)
- Deionized/distilled water rinse (second rinse)

Equipment will be decontaminated in a predesignated area, and clean bulky equipment items will be stored in their cases or on visqueen in uncontaminated areas. Cleaned small equipment items will be stored in their cases or in plastic bags. Materials to be stored more than a few hours will also be covered.

8. FIELD FORMS

During each site visit to retrieve accumulated sediment, the field crews will complete a field form which will record the following information:

- Name of staff conducting downloading
- Location
- Date/time of sampling
- Approximate volume of sediment sampled
- Condition of the sediment traps
- General comments/observations

9. ATTACHMENTS

Attachment A FMC Standard OS-8 Permit Required Confined Space Entry

Attachment B Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels

Attachment 4

Flow Monitoring SOP

1. FIELD FLOW MONITORING TECHNIQUES

The following text describes flow monitoring techniques that will be employed at specified flow monitoring locations.

2. FLOW MONITORING EQUIPMENT

The flow monitoring equipment will be ISCO 2150 Area Velocity Module flowmeters. The flow meters will be used to measure the water depth and velocity. The ISCO 2150 measures water depth in the pipe or control structure using an area velocity probe mounted in the pipe or control structure. The area velocity probe is composed of a Doppler velocity sensor and submerged pressure transducer to measure depth. The pressure transducer records all depths in excess of 0.08 ft. Velocity readings are calculated using the Doppler probe with a minimum velocity of 0.1 feet per second (fps). The flowmeter uses the velocity and the water depth to resolve a flow rate based on pipe diameter.

The flow meter is initially calibrated at the factory and characterizes the electronics to the pressure transducer. Procedure and frequency of the calibration is described in the manufacturer's instrument manual and should be followed accordingly. There is no calibration for the Doppler velocity probes. The flowmeter velocity cut-offs will be set to 0.1 (fps) with a default of 0.0 fps.

The 2150 is typically powered by either two alkaline or Teledyne ISCO Rechargeable Lead-acid batteries within a 2191 Battery Module.

3. FLOWMETER LOGGING

The data logging feature of the ISCO 2150 flow meter is a required component of any flow monitoring sampling station. The flow meters will measure and log flow levels. During both dry weather and rain events, the flow meters convert instantaneous flow into total runoff volume. Data containing storm and hydrological information is electronically stored in the flow meter, with each monitoring event stored separately. The information recorded includes:

- Flow rate
- Time of peak flow rate
- Total flow

The flowmeters will be configured to log continuous 5-minute average flow. The continuous hydrological daily data records will include:

- Flow measurement in cubic feet per second (cfs) based on 5-minute intervals
- Minimum and maximum flow rates (cfs)
- Level readings (in)

Logging flow and level on 5-minute intervals will result in a need to download the data at least once every three months. The data will need to be retrieved from the flowmeters and the flowmeters reset during each download.

4. INSTALLATION METHODS

Experienced field personnel will install the equipment using securely mounted sensors with stainless steel hardware. In order to collect accurate pipe diameters and to mount the probe to the bottom of the channel/pipe, the FMC Standard OS-8 Permit Required Confined Space Entry will be followed by the field personnel. During the installation, the field crews will collect pipe measurements and mount the probe at least five pipe diameters upstream of any obstructions, turns, or turbulence. If the sensors are mounted downstream of any obstructions, the probe will be mounted 10 pipe diameters downstream of any obstructions. The sensors will be securely fastened using stainless steel brackets, screws, and anchors.

Components of the monitoring equipment will undergo calibration and verification during installation and will be calibrated and/or verified again during maintenance visits. The ISCO 2150 velocity probes will be mounted on stainless steel plates and securely fastened to the bottom of the stormwater pipe using small (0.25") stainless steel anchor bolts and nuts. The cable from the flowmeter module to the probe will be fastened to the pipe using the same hardware and protected from high flows. If necessary, the cable will be shielded using a one-inch flexible electric conduit. The module will be positioned near the top of the invert, directly beneath the manhole cover, to allow easy access for downloads and inspections. The flow module is fitted with cable strap locations which will be used to tie the module to the top ladder rung.

5. DOWNLOAD METHODS

The flowmeters will be downloaded every two months. The methods for downloading the flowmeters are presented below.

- Using safe lifting techniques, traffic controls (if needed), and implementing all health and safety protocols, open the manhole cover.
- Retrieve the flowmeter module to the surface and connect the download cable to a field laptop.
- Open Flowlink 5.
- Download the data using the software.
- Ensure the dataset has been saved to the laptop Flowlink files.
- Reset the logger and start the logger.
- Check the depth being recorded by the pressure transducer.
- Using an extendable pole with measuring stick and Kolor Kut®, verify the current measured depth is accurate (+/- 0.1ft).
- Place the flowmeter back into previous position.
- Check the security of the straps and cables used to hold the flowmeter module.
- Close the manhole cover.

During the site visits to conduct the data downloads, the field crews will check the battery voltage. If the internal 12v battery voltage is below 12v, new batteries will be installed into the modules.

6. FIELD FORMS

During each site visit to retrieve flow data from each flowmeter, the field crews will complete a field form recording the following information:

- Name of staff conducting downloading
- Location
- Date/time of download
- Condition of the manhole cover and location

- Battery voltage (new batteries installed?)
- Condition of flow meter cable (free of kinks, free of obstructions, and properly connected)
- Flow probe (clear of sediment/gravel/debris?)
- Confirm the data has been retrieved
- Confirm logger was reset
- Confirm the flowmeter is running and recording depth and flow
- General comments/observations

7. DATA MANAGEMENT METHODS

The original electronic data logger files will be saved electronically on the project file(s). Hydrographs containing flow readings, rainfall, and sample history will be created using the field measurements and data logger results and will be saved as a Microsoft Excel file.

8. ATTACHMENT

Attachment A FMC Standard OS-8 Permit Required Confined Space Entry

Attachment 5

High Volume System Sampling SOP

STANDARD OPERATING PROCEDURE (SOP) SW-27

HIGH-VOLUME STORM WATER SAMPLING FOR ANALYSIS OF COMPOUNDS WITH LOW DETECTION LIMITS

SCOPE AND APPLICATION

This SOP describes the protocol for collecting high-volume (HV) water samples using a Gravity PR2900 pump system coupled with a polyurethane foam (PUF) cartridge and a vortex separator, the collection of parallel peristaltic whole water sample, and the collection of physical sample parameters. This SOP is specific to HV techniques used for storm water sampling and augments information provided in the project planning documents (e.g. Work Plan).

High volume samples (HVS)storm water samples are collected to quantify storm water concentrations of targeted organic chemicals (e.g., dioxins, PCBs, and pesticides) that could be present at levels too low to be detected using conventional sampling methods. This method also allows for quantification of hydrophobic organic chemicals (HOCs) in the suspended particle and dissolved phases.

HV storm water sampling techniques make it possible to obtain enough mass from the storm event to allow quantitation of the target compounds. In summary, a large volume of water is collected with a pump and passed through a vortex separator and then through a cartridge containing PUF material that binds the dissolved forms of the compound in question. The dissolved compounds that bind to adsorbent foam material (i.e. the PUF) are later extracted in the laboratory and measured on a gas chromatograph/mass spectrometer. Trace metal clean sampling techniques are also used for the collection of HV water samples to be analyzed for organic compounds and conventional parameters, such as total suspended solids, dissolved organic carbon, and total dissolved solids. Using these techniques guarantees a high level of sample integrity and minimizes the potential for contamination during sample handling.

This SOP utilizes and augments the procedures outlined in the San Francisco Estuary Institute's *Field Sampling Manual for the Regional Monitoring Program for Trace Substances* (David et al. 2001), the *Interagency Field Manual for the Collection of Water-Quality Data* (USGS, various dates), and U.S. Environmental Protection Agency (EPA) Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (USEPA 1996). A goal of this SOP is to ensure that the highest quality, most representative data are collected, and that these data are comparable to data collected by different programs that follow EPA guidelines.

STATION ACCESS

Prior to entering, select areas for storm water sampling that are safe to access. It may be necessary to acquire permission from the landowner to access the property. Access permission must be acquired in advance of the sampling program and may require a written agreement.

STATION LOCATION

Water samples will be collected at specific HVS locations identified in project planning documents (e.g. Work Plan). Samples will be collected over the period of the storm event so it is necessary to ensure that the sample locations have 24/7 access.

SUMMARY OF METHOD

At each station, two lengths of dedicated/new Teflon™ tubing will be attached to a pipe with base mount and flow sensor and lowered into the storm water pipe making sure the tubing does not come into contact with any accumulated sediment. Using a peristaltic pump, the outflow from one of the Teflon™ sampling tubes and is directed into an HVS intake tube, which leads to a high vortex separator. The high vortex separator is able to separate suspended sediments by forcing the water in a centrifugal fashion before exiting towards the 0.45 micron glass filter and then the PUF cartridge. Water is then drawn through the PUF cartridge which contains solid phase extraction resins that bind dissolved forms of the compounds in question (e.g., HOCs). A constant rate of water, 1.5 L/min, is pumped through this system. Every 15 minutes the rate of water pumped is checked to ensure that water is flowing at a constant rate. To check that the pump is accurately delivering the desired rate of volume, the pump outflow must be checked with a l L graduated plastic cylinder and a timer. If the pump is not delivering the correct flow rate, fine adjustments must be made until the optimum flow is achieved.

After the desired volume has passed through the PUF cartridge, the HVS peristaltic pump is turned off and the PUF cartridge and the 0.45 micron glass filter are removed. Two stainless steel nuts that cap each end of the PUF cartridge are reattached. The cartridge is then labeled, taped, placed in resealable bags, and placed in a cooler with wet ice. The volume from the vortex separator containing the suspended particles sample is added to the 0.45 micron flat filter, and placed in a labeled 8 oz jar before being placed in a cooler with ice. The vortex sampler volume is removed by shutting the main line valve to the off position and opening the vortex outlet valve while running the pump for 10 seconds.

Physical field measurements and a separate whole water sample can be collected in tandem with the HVS sampling system by connecting the second Teflon™ tube to a secondary peristaltic pump, tubing set and carboy with mixing chamber. This pump will also have a flow-thru chamber with YSI Exo multi-meter installed for continuous measurement of

Dissolved Oxygen, PH, turbidity, and temperature. The second whole water sample can be submitted to the laboratory for analysis in accordance with project planning documents.

PROCEDURES

The sampling team should comprise two people at each location. Staff are needed to conduct the sampling and keep track of sample logging, data collection and sample processing.

Equipment Preparation

A sufficient amount of decontaminated sampling equipment will be brought to the field to minimize the amount of decontamination procedures that need to be performed between stations. SGS laboratory is responsible for preparing its equipment prior to delivery. All PUF cartridges will be cleaned, pre-weighed, numbered at the laboratory, and individually packaged before being shipped to the site under chain-of-custody. The list of necessary equipment is provided as Attachment 1 to this SOP.

The following steps are taken to set up the storm water collection system:

1. Assemble and secure the water inlet and tube at the location.
2. Set up a clean area for the sampling equipment.
3. Attach two lengths of Teflon™ tubing (collecting end) to 30-cm platinum cured silicone™ tubing and a 1-m Teflon™ tubing, sequentially, and then connect the platinum cured silicone ™ part of these interconnected pieces of tubing firmly into place inside the large peristaltic pump head. The outlet tubing should be directed away from the storm water conveyance to ensure sampled water does not drain back into the outfall. (Note: The length of the Teflon™ tubing will vary depending on project-specific requirements and storm water manhole vault height at a given station).
4. Attach the intake part of the two lengths of Teflon™ tubing to the base mounted pipe with flow sensor to be lowered into the storm water pipe. The pipe with base mount and flow sensor and tubing will then be lowered into the storm water pipe making sure the tubing does not come into contact with any accumulated sediment. The intake tubing shall be pointed in the up-pipe direction.
5. Secure the pumps and pump speed controllers and connect them to a generator or inverter with an extension cord. The generator should be positioned downwind from the sampling and should not be run while the PUF is being transferred to or from the sampler
6. Connect one of the Teflon™ tubes to a flow thru chamber to the whole water physical sample carboy and setup YSI Exo1 for water quality monitoring parameter logging.
7. Connect the other Teflon™ tube to the HVS intake tubing.

HVS Sample Collection

The following steps are taken to collect and process a standard HVS storm water sample:

1. Remove the protective cap from the sampling tube and lower the pipe with tube gently below the water surface avoiding contact with any accumulated sediment in the storm water pipe.
2. Switch the pump on and purge at least 3 tubing volumes of water through the tubing to ensure a representative sample is collected. During purge, calibrate pump flow rate to 1.5 L/min using a 1 L graduated cylinder.
3. Once purging is complete and flow rates are set, attach tubing outlet to vortex separator and pump storm water through the sample tubing into the vortex separator and through the PUF cartridge at a rate of 1.5 L/min.
4. Every 15 minutes, record pump rate to ensure that the target rate of 1.5 L/min is maintained. If the pump rate falls +/- 5% outside this range (i.e., outside of the range of 1.425 L/min to 1.575 L/min), adjust the speed of the pump.
5. Turn off the pump once the desired volume of storm water has been pumped through the PUF cartridge.
6. Remove the PUF cartridge and cap each end with stainless steel nuts.
7. Remove the 0.45 micron flat filter and place in 8 oz. jar. If multiple flat filters are collected during the sample collection pumping these will be combined in the same 8oz jar for compositing at the testing laboratory.
8. Add the solids from the vortex separator into the flat filter 8 oz. jar by shutting the main line valve to the off position and opening the vortex outlet valve while running the pump for 10 seconds to purge the vortex separator. If needed, rinse the inside of the vortex separator with a squirt bottle filled with deionized water.
9. Attach sampling label, which contains the date, time, project name or number, sample ID, type of analysis required, and sampler initials per project planning documents (e.g. Quality Assurance Project Plan [QAPP])
10. Once the PUF cartridge and solids jar are properly closed and labeled, place them inside a cooler containing wet ice and store at approximately 4°C. All samples are to be stored in coolers with ice prior to submittal and/or shipping to the analytical laboratory, per project planning documents (e.g. QAPP)

Whole Water Sample Collection

The following steps are taken to collect the whole water storm water sample:

1. Remove the protective cap from the sampling tube and lower the pipe with tube gently below the water surface avoiding contact with any accumulated sediment in the storm water pipe.
2. Switch the pump on and purge at least 3 tubing volumes of water through the tubing to ensure a representative sample is collected. During purge, calibrate pump flow rate to 1.5 L/min using a 1L graduated cylinder.
3. Once purging is complete and flow rates are set, attach tubing outlet to the whole water dedicated carboy with an in-line flow-thru chamber connected to a YSI Exo multi-meter installed for measurement of Dissolved Oxygen, PH, turbidity, and temperature set to be recorded every 15 minutes.
4. Every 15 minutes, collect 1L of whole water into the carboy.
5. Turn off the pump once the desired volume of storm water has been pumped through the HVS system.
6. Attach sampling label to the whole water sample carboy, which contains the date, time, project name or number, sample ID, type of analysis required, and sampler initials per project planning documents (e.g. Quality Assurance Project Plan [QAPP])
7. Once the carboy is properly sealed and labeled, place it on wet ice and store at approximately 4°C. All samples are to be stored on ice prior to submittal and/or shipping to the analytical laboratory, per project planning documents (e.g. QAPP)

Decontamination

The following steps are taken to decontaminate the HVS and whole water storm water sampling equipment between sample stations. The procedure specific to the HV sampling equipment is provided below.

1. Remove all silicone and Teflon™ tubing from the HVS system and whole water peristaltic pump and discard
2. Plumb decon tubing to system
3. Pump 2 liters of Liquinox® solution through PR2900 system
4. Pump 1 liter of DI water through the PR2900 system
5. Pump 1 liter of Methanol through PR2900 system
6. Pump 1 liter of DI water through PR2900 system
7. Pump 0.5 liter of Hexane through PR2900 system
8. Pump 1 liter of DI water through PR2900 system

9. Cap all exposed inlets and outlets with aluminum foil until next sample is ready for processing

WATER QUALITY MEASUREMENTS

Physical and chemical water parameters will be collected at storm water stations. Several physical and chemical water parameters are best measured in the field because of the unstable nature of the parameter or because the information is needed to direct further sampling. It is frequently preferable to perform these analyses in the field, especially if the samples will not be immediately transported to the analytical laboratory (pH, in particular, should be measured in the field if feasible). A YSI multimeter Exo1 with flow thru chamber will be used to log Dissolved Oxygen, pH, turbidity, and temperature parameters.

The YSI will run for the full duration of the sampling event to observe any potential changes in the physical parameters of the sample. The physical parameter data will be recorded every 15 minutes during sample pumping at each location.

Documentation of instrument information will adhere to project planning documents (e.g. Field Sampling Plan), and at a minimum will contain the name(s) of the person(s) making the measurement and the field equipment used to make that measurement must be recorded in the field logbook and on any field forms used during the sampling event. Equipment maintenance and calibration records must be kept in logbooks and field records so that the procedures are traceable. All field records will be checked by field staff for completeness and electronically provided to the Client.

STORMWATER FLOW MEASUREMENT

A Greyline Stingray 2.0 flow sensor will also be incorporated into the sampling program to measure flow and volume. The flow sensor transmits ultrasonic pulses that travel through the water and reflect off the liquid surface. To monitor water level, the Stingray 2.0 precisely measures the time it takes for echoes to return to the sensor. Velocity is measured with an ultrasonic signal continuously injected into the flow. This high frequency sound is reflected back to the sensor from particles or bubbles suspended in the liquid. If the fluid is in motion, the echoes return at an altered frequency proportionate to flow velocity. The Stingray 2.0 uses this Doppler frequency shift to accurately calculate flow velocity. The Stingray will be attached to the base plate of the pole used to deploy the sampling tube.

The Stingray will run for the full duration of the sampling event to observe any potential changes in the flow. The flow sensor Greyline Logger software will display and record near continuous log files and flow rates in graph and table formats. Flow data reports including minimum, maximum and average flow, and calculated flow totals will be generated.

SAMPLE HANDLING

Standard "clean and dirty hand" techniques will be observed on this project. Clean hands are required for sample collection and handling, as described above. Field staff will wear appropriate non-contaminating, disposable, powderless nitrile gloves during the entire sampling operation. Gloves will be changed frequently, usually with each change in task (wearing multiple layers of gloves allows rapid glove changes).

Clean hands are required for all operations that involve equipment that comes into contact with the sample, including the following activities:

- Handling the PUF column, 0.45 micron flat filter and vortex separator vial
- Handling the intake end of the sample tube or line
- Setting up working space inside the processing chambers
- Setting up the equipment (i.e., HVS sampler and PUF cartridges) inside the chambers
- Handling the vortex separator
- Changing the chamber covers as needed.

Dirty Hands take care of all operations that involve contact with potential sources of contamination, including the following activities:

- Working exclusively exterior to the processing and preservation chambers
- Preparing a clean workspace
- Preparing and operating the sampling equipment, including the pumps and discrete samplers
- Handling the generator or other power supply for samplers
- Handling the tools, such as hammers, wrenches, keys, locks, and sample-flow manifolds
- Handling the single or multi-parameter instruments for field measurements
- Setting up and checking the field-measurement instruments
- Measuring and recording the field measurements.

All samples are stored in coolers with ice at approximately 4°C on and transferred to the field facility at the conclusion of the sampling day. The sampling team leader is responsible for maintaining sample integrity throughout the sampling event.

Sample contamination will be avoided by handling the sample containers with clean gloves, and transferring the samples into clean refrigerators (or clean coolers) immediately after samples have been brought back from the field. Sample bottles will always be handled by personnel wearing disposable, powderless nitrile gloves. This includes any and all sample handling that may occur during sample packing and shipping.

REFERENCES

David, N., D. Bell, and J. Gold. 2001. Field sampling manual for the Regional Monitoring Program for Trace Substances. San Francisco Estuarine Institute, San Francisco, CA.

USEPA. 1996. Method 1669 - Sampling ambient water for trace metals at EPA water quality criteria levels. U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303). Washington, DC.

USGS. [various dates]. National field manual for the collection of water-quality data: U.S. Geological Survey techniques of water-resources investigations, Book 9, Chap. A1-A9. Available online at http://pubs.water.usgs.gov/twri9A. U.S. Geological Survey. Accessed February 5, 2008, at http://water.usgs.gov/owq/FieldManual/index.html#Citation.

ATTACHMENT 1. FIELD EQUIPMENT LIST

- HV peristaltic pump with vortex separator
- Teflon™ tubing
- YSI Exo1 water parameter multi-meter capable of measuring pH, reduction/oxidation (redox) potential, temperature, specific conductance, turbidity, and dissolved oxygen
- Teflon™-lined polyethylene sample tubing (length is site dependent)
- Platinum cured silicone tubing
- Plastic zip-ties
- Water Sampling Log forms
- Sample tags/labels and appropriate documentation (e.g., chain-of-custody forms)
- Insulated cooler(s), chain-of-custody seals, Ziploc® bags
- Sample containers (PUF cartridges, vortex separator vials)
- Coolers
- Wet ice
- Nitrile gloves
- First aid kit
- Eye wash kit
- Duct tape
- Clear tape
- Packing tape dispenser
- Tool box
- Coated weights for water samplers
- Non-metallic wire for winch spool
- 2000 watt power generator or inverter
- Paper towels
- Dilute solution of Liquinox
- Deionized water
- Extension cord
- Power strip
- Resealable plastic bags (i.e., 1 gallon and 1 quart)
- Yuma Trimble
- IDW containers
- Methanol
- Hexane
- 0.45 micron flat filters

Attachment 6

In-River Sediment Trap SOP

STANDARD OPERATING PROCEDURE (SOP) SW-31

SEDIMENT TRAP INSTALLATIONS & REMOVAL

SCOPE AND APPLICATION

The following standard operating procedure (SOP) details the steps involved in the installation and removal of sediment traps on the sea floor or river bottom.

Station Access

Prior to entering select areas such as private beaches, embayments, or proximity to docks, it may be necessary to acquire permission from the landowner to access the property. In addition minimum water depths for vessel traffic need to be considered for each location. Access permission must be acquired in advance of the sampling program and may require a written agreement.

Station Location

Sediment traps will installed and locations defined in project clients Work Plan.

Positioning & Coordinates

A differential global positioning system (DGPS) will be used aboard the sampling vessel for accurate station positioning (see project planning documents). Once the vessel is anchored in place, the actual position will be recorded for installed and/or attempted deployment locations. Horizontal coordinates should be recorded in North American Datum of 1983 (NAD83), State Plane Coordinate System – Oregon North, with units in International Feet.

Water depths will be recorded in meters from the vessel bow sonar and with the use of a lead line and converted to NAVD88 using the USGS gauge at the Morrison Street Bridge in Portland, OR..

Safety And Hazardous Materials Management

General Lab Safety- All general laboratory safety practices will be complied with, including wearing rain gear or lab apron, safety glasses, and gloves. Samples will be treated with regard to possible toxicity and microbiological potential.

This method may involve the use of corrosive and caustic reagents as well as chemicals that pose contact hazards. Care should be taken to avoid skin contact or inhalation of these chemicals. SOP 28 provides specific methods for the handling of Sodium Azide a preservative used in the sediment traps.

The vessel skipper has ultimate responsibility for safety while the vessel is underway. During deployment of equipment, the operator and the skipper must communicate with one another to avoid potential loss of the instrument due to propeller interface with the underwater field cable.

SUMMARY OF METHOD

Samples will be collected from a vessel at predefined sampling locations. The vessel should be equipped with the necessary equipment to safely operate and navigate and complete the required sampling tasks. Additionally, the proper vessel should be selected for stations in shallow areas which may preclude larger vessels due to draft limitations.

PROCEDURES

The deployment team should comprise two people. The sampling/retrieval team should comprise three people. Two people are needed to conduct the sampling and a third person is required to keep track of sample logging and sample processing. In addition, the third person may be responsible for collecting the data parameters.

Equipment

Sediment Trap Design

The sediment trap dimensions, ratio and cluster design, and deployment methods are consistent with methods used in the Portland Harbor Remedial Investigation/Feasibility Study Final Remedial Investigation Report (USEPA, 2016a). The sediment traps, utilized by Gravity are known as the ST-30 design and are the same ones that were used in the PHSS PDI-BL. Sediment traps will consist of four glass tubes sized 15 cm in diameter and 80 cm long mounted upon a common deployment platform constructed of protective polyvinyl chloride rings fastened together. Baffles will not be used. Each tube will contain approximately 1 liter of high salinity water (dense salt) and sodium azide or formalin preservative to help maintain the integrity of the samples and confirm that the cylinder has remained upright during deployment (i.e., check the salinity of the water). Sediment traps are designed with a 5:1 height-to-diameter ratio. The sediment trap is placed above the mudline with the open top of the cylinders 3 feet above the mudline. This height was determined to ensure sediments are collected settling from the water column and not from re-suspension of bedded sediments and has been used effectively at other sites (Norton, 2001).

The following equipment is necessary for sampling surface sediments:

- Sediment Trap

- Timer release – ET100
- Sufficient line to lower instrument to sea floor and retrieve
- Decontamination equipment for cleaning between stations such as Alconox detergent, cleaning brushes, distilled or deionized water
- Nitrile gloves
- Stainless steel utensils for processing
- Subsampling containers for laboratory analysis
- Coolers for sample storage
- DGPS for station positioning
- Field Note Book/ Field Log Sheets

Trap Installation

Once the vessel has navigated to position and been securely anchored, the traps will be prepared with Sodium Azide and Salt solution and deployed over the side of the vessel. A camera will be utilized to ensure sediment traps are set on the bottom correctly.

Deployment checks:

- Ensure the drag lines are installed at 20' lengths
- Ensure timer is set to appropriate number of days
- Inspect all bolts for tightness
- Test camera prior to deployment

After inspection the traps can be carefully lowered to the seabed. A camera attached to the main winch line will monitor the descent and settling of the traps to ensure they land in a flat spot and are secure. Drag lines at 20' will be set upstream and downstream of the trap as a secondary safety for recovery of the trap array.

Recording

Information to be recorded during deployment:

- Station ID
- Sampling Vessel
- Name of Sampler
- Station Coordinates (coordinate datum)
- Weather conditions
- Sample time and date
- Water depth
- Camera observations of bottom
- Presence of sheen on water
- Observed debris (wood debris, shell hash…etc)

Trap Removal

Once the desired trap soak time is complete the samples will be recovered. The vessel will anchor on the actual marked location and prepare for recovery. Assuming the timer for the release is successful the vessel deckhand will hook the recovery line and connect to vessel winch for retrieval. If the release did not occur the deckhand will carefully drag the area near the sampler to recovery one of the two drag lines. Once the trap is collected and on deck each sediment tube will be removed from the array and stored in a rack. The glass tubes will be removed from the assembly, kept upright, and allowed to resettle, if needed. The thickness of accumulated sediment will be measured at multiple points around each tube to account for sloping of sediment within the tube and recorded on the Field Logs. Overlying water will then be siphoned or pumped off from each glass tube. Sediments from each tube will be characterized and described on the Field Logs prior to compositing. Once characterized, sediments will be collected in a either a decontaminated stainless-steel bowl or new disposable aluminum pan and homogenized until uniform color and consistency is achieved via mixing with a decontaminated stainless-steel (or disposable) spoon. Once homogenized, sediments will be placed in the appropriate laboratory-provided sampling containers (Table 5) and stored in a cooler at 0 to 6°C until transported to the laboratory. Sample handling and transport procedures outlined in the *QAPP* will be followed.

Decontamination

The traps will be be thoroughly cleaned prior to use between sampling events. The decontamination procedure should follow the following steps:

- Scrub surface with brush and Alconox soap solution.
- Rinse with distilled or deionized water.
- Rinse thoroughly with site water at corresponding location.

All hand work will be conducted with disposable nitrile gloves which will be rinsed with distilled or deionized water before and after handling each individual sample, as appropriate, to prevent sample contamination. Glove will be disposed of between composites to prevent cross contamination between samples.

DATA QA/QC

To ensure the quality of sample data, a chain of custody (COC) form will be populated to document the samples from the date of collection to the date of receival by the laboratory. A separate COC form will be created for each cooler listing the sample ID for every container included and the intended analysis.